Online ISSN : 2249-4626
Print ISSN : 0975-5896
DOI : 10.17406/GJSFR

Global Journal

of Science Frontier Research: D

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Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 8 VERSION 1.0

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

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Agriculture & Veterinary
Volume 16 Issue 8 (Ver. 1.0)

Open Association of Research Society

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Packaging & Continental Dispatching

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200 USD (B/W) & 250 USD (Color)

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Contents of the Issue

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effectiveness of Different Spay Timing Methods for the Control of Lepidopteron Pests in Cotton

By Mapuranga Rangarirai, Jimu Francis & Mubvekeri Washington
Cotton Research Institute

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Keywords: *helicoverpa armigera, diparopsis castanea, threshold, pest, spraying, predators.*

GJSFR-D Classification: *FOR Code: 070199*

Strictly as per the compliance and regulations of :

Effectiveness of Different Spay Timing Methods for the Control of Lepidopteron Pests in Cotton

Mapuranga Rangarirai [α], Jimu Francis [σ] & Mubvekeri Washington [ρ]

Abstract- Background: Application of chemicals for the control of *Helicoverpa armigera* and *Diparopsis castanea* is based on egg threshold, while for *Erias insulana* and *E. biplaga* larval counts are used. In Zimbabwe the traditional farmer practice involves use of weekly spraying, fortnightly spraying and spraying at first sight of damaged squares. The methods may be less effective, costly, damaging to the environment and labour intensive. Experiments were conducted for three consecutive seasons from 2010/11 season up to 2012/13 season to evaluate the spray timing methods. Spraying at bollworm egg threshold level was the standard. The trial was laid as a randomised complete block design replicated four times at Cotton Research Institute, Dande and Umguza.

Results: Analysis of variance was done on bollworm larval counts and seed cotton yield using Genstat 14th version of 2011. The standard method and weekly spraying produced comparably reduced larval counts. Fortnightly spraying and spraying at first sight of damaged squares was less effective in control of bollworms. The standard method significantly spared predators at most sites over the three seasons in contrast with weekly spraying. However predator counts for standard and the other methods were comparable. Results of cost-benefit analysis done only in 2012/13 showed that weekly spraying was most expensive than other methods.

Conclusion: The standard method continued to be the best spray timing method for farmers.

Keywords: helicoverpa armigera, diparopsis castanea, threshold, pest, spraying, predators.

I. Introduction

A good scouting programme is still the first line of defence against insect pests in cotton (Greene, 2012). Sucking pests, spiny bollworm larvae (*Erias insulana* and *E. biplaga*), leaf eaters, soil pests and many other pests of cotton are easily identified by smallholder farmers, making it easier for them to make a decision to spray or not. However problems arise with bollworms (African bollworm, *Helicoverpa armigera* Hub. and red bollworm, *Diparopsis castanea*), where the recommended method is to scout for bollworm eggs (Cotton Growers Association, 1998), and these bollworm eggs are very small, usually the size of a pin head (ANR-0409, 2012) and difficult to identify. A survey which was carried out in 1994 showed that 38% and 36% of farmers could not recognise red and heliothis bollworm eggs yet 94% and 75% of the same group of farmers can easily identify the larval stages (Jowah, 1994). In seasons with above normal rainfall bollworm eggs change from their usual blue and creamish white colour to greyish for red and heliothis bollworms respectively. For most farmers who are elderly and with poor eye sight they can`t recognise these eggs. The small bollworm eggs are also deposited singly (Greene, 2012) further increasing problems to farmers during scouting.

The difficulties experienced by farmers in trying to identify bollworm eggs have led them to stop basing decisions of when to spray on economic threshold data as recommended but they now do routine sprays based on their own perceptions. Some farmers have resorted to weekly sprays, others apply fortnightly sprays, and the majority spray after observing a fallen damaged square which is a sign of the presence of the 1st instar larva. This method has been recommended in various countries such as South and North Carolina, Virginia, Columbia (Greene, 2012; Boyd *et al*, 2004). Only a small fraction of farmers use the recommendations of the Zimbabwe Cotton Handbook where one should make use of bollworm eggs threshold scouted on 24 plants over an area on not more than 24 hectares. However, all these methods employed by farmers may be less effective and costly which would increase total production costs for these farmers. It is therefore essential to find an alternative, effective and cost saving spray timing method for use by these small-holder farmers among the different methods they are using.

The aim of this study was to evaluate the effectiveness of the different spray timing methods used by smallholder farmers with the following specific objectives

- To determine the method which can maintain low bollworm larval counts
- To determine the method which can spare a high population of predators
- To determine the method which can preserve high seed cotton yield
- To determine which spray timing method is economical

II. Materials and Methods

This study, which began in 2010-2011 season, was repeated in 2011-12 and 2012-2013 season at Cotton Research Institute, (CRI). In the first season the experiment was established at CRI and Chisumbanje

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and at Dande, CRI and Mvuma in the second season and in the final season it was laid at Dande, CRI and Umguza. The experiment was laid out in a randomized complete block design with five treatments replicated 4 times at all sites. The treatments evaluated in this study are described on Table 1 below.

Cotton variety used across all sites in all seasons was SZ9314, it was hand planted. Seeds were spaced at 0.3m in rows which were 1m apart in plots measuring 22m by 14 rows. Compound L (5:18:10) was used as basal treatment applied at 200kg/ha at planting and Ammonium nitrate (34.5%N) at 100kg/ha was applied at flowering.

Table 1: Description of different spray timing methods and control treatments evaluated

No.	Treatment name	Treatment description
1	Control	No chemical control of major bollworms (African, spiny and red bollworms)
2	Standard or threshold control	Spray when egg/larval counts reaches or exceed the recommended threshold levels (6 or 12 eggs/24 scouted plants red and African bollworm respectively and 6 larvae/24 scouted plants for spiny bollworm)
3	Weekly spraying	Weekly spraying against major bollworms
4	Fortnightly spraying	Fortnightly spraying against major bollworms
5	Damaged square	Spraying at first sight of at least three fallen and damaged squares/ buds on 24 scouted plants

Planting was done at the start of every farming season at all sites, usually late November to mid December of each season. Four weeks after emergence seedlings were thinned to one plant per station. Scouting for red, spiny and African bollworms and other pests started soon after thinning. Scouting was done once weekly.

Six plants were scouted per plot which translates to 24 plants per treatment. All plants were scouted using the stepped traverse method in each plot. Other pests, sucking pests and leaf eaters were controlled when they reached or exceeded their recommended economic thresholds on 24 scouted plants selected randomly over the whole trial area. Weekly egg and larval counts of African, red and spiny bollworms and predators (larva and adult ladybird beetle, crysopa and spiders) were recorded. An analysis of variance (ANOVA) on the data were done using Genstat 14.1 version. ANOVA was also carried out on combined data for all sites by each season (across site analysis). Larval counts were transformed using the square root of count plus ⅜ (i.e. $\sqrt{(\beta + ⅜)}$), where β is equal to observed parameter.

III. Results

a) Effects of different spray timing methods on bollworms in 2010 – 11 season

There were significant differences among treatment means on red, African and spiny bollworm larval counts ($p < 0.05$, Table 2). The results show that the weekly, fortnightly and spraying at first sight of damaged squares were not significantly different from the standard method but they were however significantly different from the control which had the highest population of red, African and spiny bollworm larvae.

Table 2: Effect of different spray timing methods on number of Red and African bollworm larval stages at CRI in 2010/11 cropping season

	Dande			CRI		
Treatment	African	Red	Spiny	African	red	Spiny
No control of bollworms				1.1b	1.7b	1.3b
Threshold method				0.6a	0.8a	0.6a
Weekly spray				0.6a	0.6a	0.6a
Fortnightly spray				0.6a	1.0a	0.6a
Damaged square				0.9ab	1.3ab	0.6a
Mean				0.8	1.1	0.7
P-value				0.032	0.046	<.001
LSD (0.05)				0.3	0.9	0.2
CV (%)				17	23	5

Means within a column not followed by a common letter are significantly different at 5% level by LSD comparison

b) Effects of different spray timing methods on bollworms in 2011 – 12 season

There were significant differences ($p \leq 0.05$) for larval counts for African and red bollworms at CRI, Dande and Mvuma (Table 3). Weekly spraying kept bollworm larvae at CRI below the level of the standard method ($p < .001$) whereas fortnightly spraying and spraying after first sight of damaged squares, bolls or

buds had lower control as compared to the standard method. Dande results show significant differences for African bollworm larvae ($p < .001$) and red bollworm larvae ($p = 0.003$). Weekly spraying managed to check African bollworm larvae below, but comparable to the threshold method. Fortnightly spraying had poor control than weekly spraying and threshold method. The lowest red bollworm count was recorded in the threshold method and was comparable to all test treatments. The no spray recorded the highest count in all cases.

Table 3: Effect of different spray timing methods on number of Red and African bollworm larvae stages at Dande, CRI and Mvuma in 2011/12 cropping season

	Dande		CRI		Mvuma	
Treatment	African	Red	African	Red	African	Red
No control of bollworms	14.58a	3.83a	2.18a	1.08a	0.65a	0.35a
Threshold method	3.5c	0.83b	0.80c	0.40b	0.29b	0.10b
Weekly spray	2.67c	0.92b	0.61c	0.25c	0.15b	0.02b
Fortnightly spray	5.17b	1.00b	1.25b	0.60b	0.13b	0.08b
Damaged square	4.04bc	1.62b	0.98bc	0.45b	0.19b	0.17b
Grand mean	5.99	1.64	1.16	0.56	0.28	0.15
P-value	<.001	0.003	<.001	<.001	0.006	0.020
LSD (0.05)	1.40	1.48	0.45	0.29	0.27	0.18
CV (%)	4.4	9.3	3.3	2.7	2.6	35.9

Means within a column not followed by a common letter are significantly different at 5% level by LSD comparison

At Mvuma the no spray had a significantly higher count of African ($p = 0.006$) and red ($p = 0.020$) bollworm larvae. The alternative spray timing methods were comparable to the recommended threshold method in both cases.

c) *Effects of different spray timing methods on bollworms in 2012-13 season*

The 2012 – 13 season results showed significant differences for egg and larval counts for heliothis, red and spiny bollworms at CRI, Dande and Umguza ($p \leq 0.05$). Results at CRI showed significant differences for both heliothis ($p = 0.038$) and spiny ($p = 0.011$) bollworm larvae among treatment means (Table 4).

Weekly spraying kept African bollworm larvae at CRI below the level of the recommended threshold method whereas fortnightly spraying and spraying after first sight of damaged squares, bolls or buds had poor control as compared to the threshold method. Spiny bollworm larvae were highest in the weekly spraying and it was comparable to damaged squares. Significantly low spiny bollworm larvae were recorded in the threshold method and it was comparable with the no spray and fortnightly spraying.

Dande results show significant differences for African ($p < 0.001$) and red ($p = 0.045$) bollworm larvae ($p \leq 0.05$). The weekly spraying, fortnightly spraying and spraying at first sight of damaged plant part were not significantly different from the recommended threshold method. They all maintained a lower level of African bollworm larvae and red bollworm larvae when compared to the no control. Fortnightly spraying had poor control, but with no statistical differences, than weekly spraying and threshold method. The control recorded the highest count in all cases. At Umguza there were no significant differences ($p = 0.033$) among treatment means with regards to red bollworm larvae while all test treatments were comparable to the recommended method but had lower larval counts than the control. There were no significant differences among treatment means for African bollworm larvae.

Table 4: Effect of different spray timing methods on number of red, African and spiny bollworms larvae at Dande, CRI and Umguza during 2012/13 cropping season

	Dande		CRI			Umguza	
Treatment	African	Red	African	Red	Spiny	African	Red
No control of bollworms	6.12 b	1.82 b	1.88 b	1.06	0.42 ab	0.79	0.54 b
Threshold method	1.54 a	1.21 a	1.33 a	0.88	0.17 a	0.21	0.36 ab
Weekly spray	1.79 a	0.93 a	1.30 a	1.56	1.00 c	0.21	0.14 a
Fortnightly spray	1.61 a	1.07 a	1.58 ab	1.06	0.50 ab	0.58	0.21 a
Damaged square	1.82 a	1.25 ab	1.75 b	1.00	0.75bc	0.33	0.11 a
Mean	2.57	1.26	1.57	1.11	0.56	0.43	0.27
P-value	<.001	0.045	0.038	NS	0.011	NS	0.033
LSD (0.05)	1.14	1.48	0.413	0.647	0.401	0.50	0.29
CV (%)	10.7	12.4	17.1	13.7	15.5	19.0	13.6

Means within a column not followed by a common letter are significantly different at 5% level by LSD comparison

d) Across site analysis by seasons on accumulated bollworm larval counts

Across site analysis for all the sites for 2011 – 12 and 2012 – 13 seasons revealed significant differences among treatment means (Table 5). In 2012 – 13 season there were significant differences among treatment means with regards to African bollworm larvae ($p < 0.001$). The lowest larval count was recorded in the threshold method and was comparable to all experimental treatments while the no spray had significantly high larval counts. Spiny bollworm larvae was significantly high ($p = 0.007$) in weekly spraying and was comparable with damaged squares. The threshold method had the lowest spiny larval count which was comparable with fortnightly spray and no control. Red bollworm larvae had no significant differences.

The 2011 – 12 season had significant differences in African ($p < 0.001$) and red ($p < 0.001$) bollworm larval counts. The lowest African bollworm larval count was in weekly spraying and was comparable with the threshold method while the highest count was in no control. The highest red bollworm larvae were recorded in the no spray and all other treatments were not significantly different from each other.

e) Effects on different spray timing methods on beneficial organisms

Significance differences among treatment means regarding crysopa eggs ($p < 0.001$) and ladybird larvae ($p = 0.005$) were recorded for 2012/13 season (Table 6). Crysopa eggs were significantly high in the untreated control. The standard method of spray timing spared crysopa eggs and was comparable to the use of damaged square while weekly and fortnightly spraying did not preserve predators and were comparable to each other.

There were significant ($p = 0.005$) differences among treatment means on ladybird beetle larvae. The untreated control had the highest count of larvae and was statistically different with all other treatments. All the other treatments were comparable to each other.

Table 5: Mean accumulated bollworm larval counts across three sites

	2012 – 2013 season			2011-2012 season		
Treatment	African	Red	Spiny	African	Red	Spiny
No control of bollworms	22.08b	6.92	0.42ab	31.06c	9.63b	0.56
Threshold method	8.42a	4.83	0.17a	9.75ab	2.63a	0.13
Weekly spray	8.92a	4.58	1.00c	7.13a	2.06a	0.13
Fortnightly spray	10.17a	4.42	0.50ab	12.63b	3.44a	0.06
Damaged square	10.75a	4.50	0.75bc	10.88b	4.13a	0.56
Grand mean	12.07	5.05	0.56	14.29	4.38	0.287
P-value	<.001	0.069	0.007	<.001	<.001	0.054
LSD (0.05)	2.971	2.258	0.4040	3.336	2.173	0.453
CV (%)	14.7	24.1	23.6	15.5	28.4	37.9

Means within a column not followed by a common letter are significantly different at 5% level by LSD comparison

Table 6 : Effect of different spray timing methods on number of predators in 2010/11 season

Treatment	Crysopa eggs	Crysopa larvae	Ladybird larvae	Ladybird adult	Spiders
No control of bollworms	17.25c	1.75	5.50b	0.50	7.00
Threshold method	10.25b	0.25	2.50a	0.50	6.25
Weekly spray	4.25a	0.25	0.25a	0.25	3.75
Fortnightly spray	5.50a	0.25	1.25a	0.25	2.75
Damaged square	8.50ab	0.00	1.25a	0.25	3.75
Mean	9.15	0.50	2.15	0.35	4.7
P-value	<.001	NS	0.005	NS	NS
LSD (0.05)	4.467	NS	2.44	NS	NS
CV (%)	27.7	17	10	11	9.5

Means within a column not followed by a common letter are significantly different at 5% level by LSD comparison

Across site analysis with regards to beneficial organisms for 2012 – 13 season shows that significant differences among treatment means were only recorded for crysopa eggs ($p = 0.003$) and spiders ($p < .001$) (Table 7). The highest count of crysopa eggs was in the threshold method and was comparable with the no spray and damaged squares. Fortnightly spraying had the lowest egg count and was statistically not different from weekly spraying. The no control had the highest spider count. The lowest spider count was recorded in

the weekly spraying and was comparable with fortnightly spraying and the threshold method. For 2011 – 12 season significantly (p = 0.006) high crysopa egg count was recorded in the no spray and all other treatments were comparable (Table 8). The no control also recorded the highest crysopa larval count and also with the threshold method but significantly (p = 0.049) different weekly and fortnightly spraying. Ladybird beetle adult counts were highest in the no spray and were comparable with damaged squares. The threshold method, weekly and fortnightly spraying were comparable. The significantly (p = 0.006) low spider counts were recorded in fortnightly spraying and were statistically similar to weekly spraying and threshold method. The no control had the highest spider count and was comparable with damaged squares and threshold method.

Table 7: Mean accumulated count of predators 2012 -13 season on three sites

Treatment	Crysopa eggs	Crysopa larvae	Ladybird larvae	Ladybird adult	Spiders
No control of bollworms	5.75c	1.08	1.17	1.08	6.67c
Threshold method	6.25c	0.50	1.33	1.08	4.08ab
Weekly spray	4.00ab	0.75	0.83	0.58	2.58a
Fortnightly spray	3.333a	1.33	0.50	1.33	3.58ab
Damaged square	5.08bc	0.75	1.00	0.67	5.08b
Mean	4.88	0.88	0.97	0.95	4.40
P-value	0.003	0.410	0.171	0.196	<.001
LSD (0.05)	1.620	0.796	0.683	0.728	1.527
CV (%)	20.8	38.3	26.2	29.1	21.7

Means within a column not followed by a common letter are significantly different at 5% level by DMRT comparison

Table 8: Mean accumulated count of predators 2011 -12 season on four sites

Treatment	Crysopa eggs	Crysopa larvae	Ladybird larvae	Ladybird adult	Spiders
No control of bollworms	11.50b	2.13b	4.50	4.56b	7.25b
Threshold method	8.69a	1.56ab	2.69	2.44a	5.69ab
Weekly spray	8.81a	0.81a	2.50	2.50a	4.56a
Fortnightly spray	7.63a	1.00a	3.31	2.38a	4.50a
Damaged square	8.81a	1.31ab	4.50	4.19b	6.44b
Mean	9.09	1.36	3.50	3.21	5.69
P-value	0.006	0.049	0.205	0.003	0.006
LSD (0.05)	2.207	0.912	1.822	1.351	1.681
CV (%)	18.2	37.8	39.1	28.2	21.6

Means within a column not followed by a common letter are significantly different at 5% level by LSD comparison

f) Effects of different spray timing methods on seed cotton yield

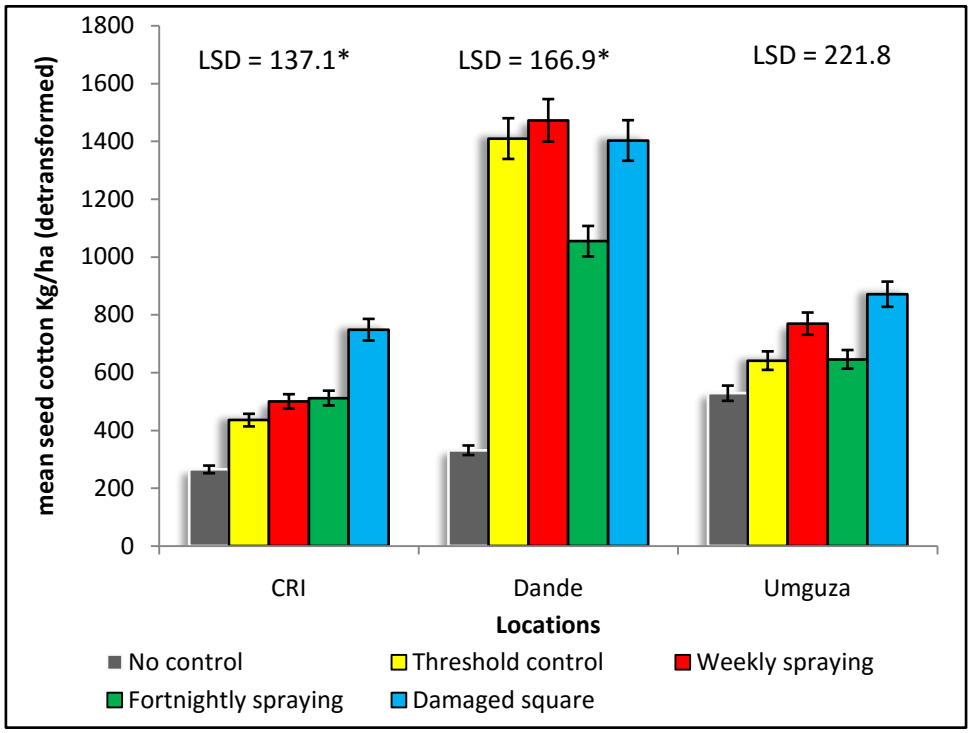

Figure 1: Mean seed cotton yield Kg/ha for 2012 – 13

Figure 1 displays seed cotton yield per hectare for CRI, Dande and Umguza. At Dande yield for control was significantly lower than all the other treatments, fortnightly spraying had intermediate yield while the threshold control, weekly spraying and spraying at first sight of damaged square had high seed cotton yields which were not significantly different from each other.

Comparison of seed cotton yield at CRI shows significant differences among treatment means with the control having the lowest yield. The intermediate yield was recorded for weekly spraying, fortnightly spraying and the threshold method. Significantly high yield was recorded in spraying at first sight of damaged squares or buds.

At Umguza the highest yield was recorded in spraying at first sight of damaged squares which was not significantly different from the threshold method, weekly and fortnightly spraying. The last three were also comparable to the control which recorded the lowest yield per hectare.

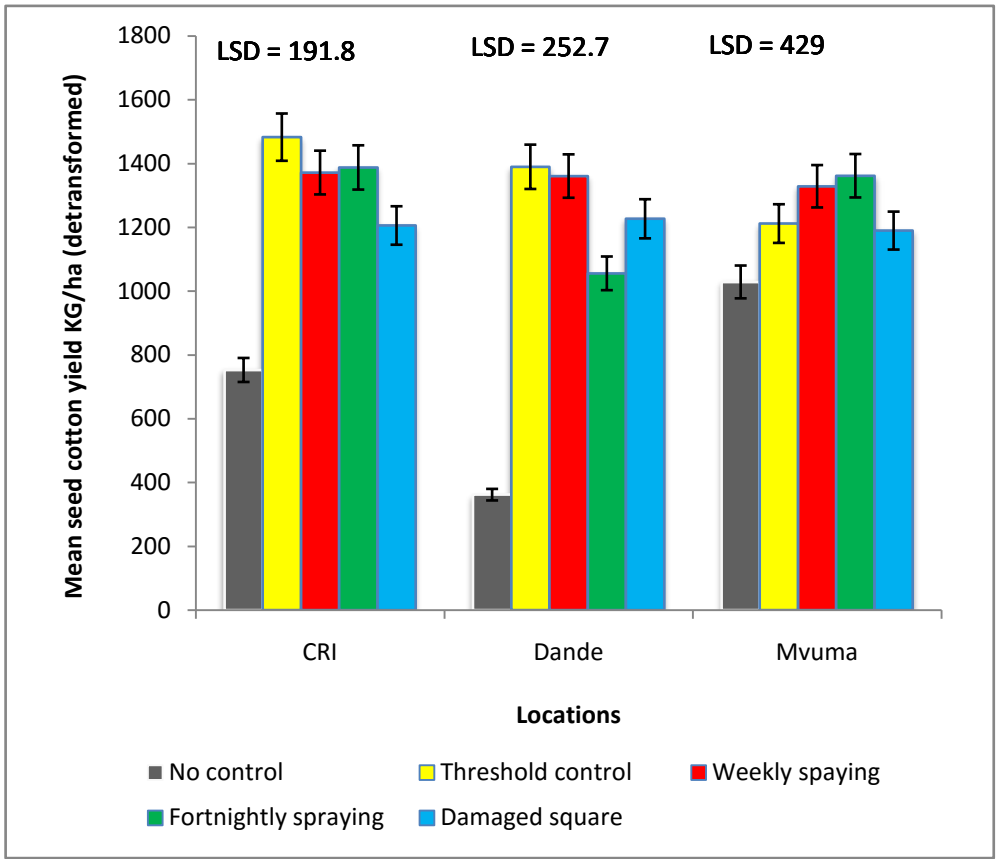

Figure 2: Mean seed cotton yield Kg/ha for 2011 – 12

Figure 2 displays seed cotton yield per hectare for Dande, CRI and Mvuma for 2011 to 2012 cropping season. At Dande yield for control was significantly lower than all the other treatments, fortnightly spraying had intermediate yield while the threshold control, weekly spraying and spraying at first sight of damaged square had high and comparable seed cotton yields. Comparison of seed cotton yield at CRI shows significant differences among treatment means with the control having the lowest yield. The intermediate yield was recorded for weekly spraying, fortnightly spraying and spraying at first sight of damaged squares whilst the highest yield was achieved in the threshold spraying but it was comparable to weekly and fortnightly spraying. Different spray timing methods did not produce significant differences for seed cotton yield at Mvuma. However biological differences were recorded; the order of yield was: no control of bollworms, spraying after noticing at least three damaged squares, threshold spraying, weekly spraying and fortnightly spraying, lowest to highest yield respectively. Generally, weekly and fortnightly spraying produced yields which were comparable to threshold method and sometimes higher. These spray timing methods were also effective in keeping lower counts of bollworm eggs and larvae when compared to the threshold method.

g) Cost benefit analysis of weekly and fortnightly spraying

An economic analysis of the weekly and fortnightly spraying shows that the two methods were more expensive than the standard method but the weekly spraying method was most expensive than both the methods (Table 6).

Table 6: Total variable costs (US$) associated with spray timing methods for 2012 – 13 season at CRI, Dande and Umguza

Site/Treatment	ET	Weekly	Fortnightly	Difference with ET	
				Weekly	Fortnightly
CRI	1050.59	1202.94	1109.10	(152.35)	(58.51)
Dande	1139.02	1318.09	1143.19	(179.05)	(4.17)
Umguza	1071.00	1208.74	1088.83	(137.74)	(17.83)

IV. Discussion

The weekly spraying generally performed comparable to the recommended threshold method in keeping low counts of red and heliothis bollworm larvae. Red and African bollworm counts were low indicating good performance of pesticides. Fortnightly spraying had poor control of bollworms in most incidences owing to the fact that pest populations may rise significantly before sprays are applied. This finding is similar to that established in Zambia (Javaid, 2008). It was found out that routine spraying (such weekly and fortnightly) always gave low yields than scouting based sprays. *H. armigera* thresholds of 0.5 eggs per plant in Zambia are the same with those in Zimbabwe often described as 12 eggs per 24 plants (Cotton Growers Association, 1998; Javaid, 2008). Fortnightly spraying at Dande and Umguza had low yield owing to the fact that bollworm incidence, especially African bollworm were very high and thus the crop was exposed to pest damage for long before sprays could be applied. Routine sprays are not suitable because they increase the risks of environmental contamination because less than 1% of applied insecticides actually reach the target (Daka, 2003). A considerable proportion of the poison is deposited in water and soil bodies.

V. Conclusion

The use of economic threshold for spray timing was the most effective in controlling bollworms, cheapest and spared more predators; it thus continues to be the best spray timing method for use by cotton farmers in Zimbabwe. The method is effective and cheap as compared to other methods.

VI. Recommendation

Scouting for red and African bollworm eggs and spiny bollworm larvae should be done before any pesticide sprays can be done in cotton. Cotton growers should continue scouting their fields to determine bollworm infestation levels before applying pesticides.

Competing interests

The authors declare no competing interests

Funding

It was the sole responsibility of the Government of Zimbabwe to fund this work.

III. Acknowledgements

We would like to thank the staff at the Entomology section at Cotton Research Institute for their contribution during project implementation and data collection.

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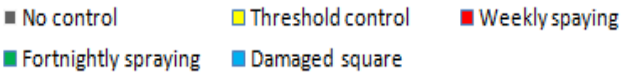
Legend for seed cotton yield graphs (for Figure 1 and 2)



Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Participatory on - Farm Evaluation and Demonstration of Improved Herbaceous Forage Species in Irrigated Lowlands of Dassench Woreda of South OMO Zone

By Denbela Hidosa & Worikicha Hitiso
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Abstract- Participatory on farm improved forage species evaluation was conducted at Keelewe Peasant association of Dassench Woreda of South Omo Zone in the 2014 under irrigated condition using the improved forage legumes to identify the adaptable and high biomass yielding forage species. The field experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications per tested species. The improved forage legume species tested in this study were *Lablab purpureus, Lablab intoritum* and *Vigna unguiculatium.* The dry matter yield obtained in this study revealed that there was none significance difference ($p > 0.05$) among the tested improved forage legume species in the study area. The dry matter yield production potential of tested species under irrigated condition in to the study area is 15.91, 14.16 and 15.40 t/ha for *Lablab intoritum, Lablab purpureus* and *Vagigna ungulatium* respectively.

Keywords: *dry matter yield, lablab intoritum, lablab purpureus, vigna unguiculatium.*

GJSFR-D Classification: *FOR Code: 309999p*

Strictly as per the compliance and regulations of :

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Abstract- Participatory on farm improved forage species evaluation was conducted at Keelewe Peasant association of Dassench Woreda of South Omo Zone in the 2014 under irrigated condition using the improved forage legumes to identify the adaptable and high biomass yielding forage species. The field experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications per tested species. The improved forage legume species tested in this study were *Lablab purpureus, Lablab intoritum* and *Vigna unguiculatium.* The dry matter yield obtained in this study revealed that there was none significance difference ($p > 0.05$) among the tested improved forage legume species in the study area. The dry matter yield production potential of tested species under irrigated condition in to the study area is 15.91, 14.16 and 15.40 t/ha for *Lablab intoritum, Lablab purpureus* and *Vagigna ungulatium* respectively. Out of the tested forge legume species over cropping season under irrigated condition, the one which gave the maximum dry matter yield was *Lablab intoritum* which gave (16 tones ha^{-1}) and *Vagigna ungulatium* (15.40 tones ha^{-1}) are advisable for the study areas. Therefore, it is imperative to evaluate the forage species for more seasons under similar condition and in addition to their feeding value under different intervention, chemical composition, their response to the disease and pest resistance, seed producing potential and dry matter production potential of species under supplementation different level of fertilizer rate.

Keywords: dry matter yield, lablab intoritum, lablab purpureus, vigna unguiculatium.

I. Introduction

Livestock are an important section of agriculture in Ethiopia and has been provided milk, meat, draught power, transport, manure, hides, skins (Funk et al., 2012) and it has been served as a source of income for the country (Feki, 2013). Conversely, it has also contributed about 15-17% of the total gross domestic product (GDP) and 35- 49% of the TADP (ATA, 2012). However, despite of the huge potential in terms of high livestock population and presence of diverse agro-ecologies suitable for livestock production in the country, the productivity and production that generated from the sector is in very low when it compared with other African countries (Belete *et al.,* 2010; Gebremedhin *et al.,* 2004). This is due to poor animal nutrition (Duguma *et al.,* 2012). Similarly, in the study area which is lowland part of Ethiopia, dominated with pastoral production system, the livestock husbandry system has been entirely depended on rangeland feed resources (Aschalew *et al.*, 2004) which is insufficient to provide nutrients requirements beyond their maintenance requirement. Therefore, in order to mitigate such a nutritional issues and improve t the livestock productivity performance, it is imperative to introduce and evaluate high-quality and yielding herbaceous forage legumes species. Among the improved forage species introduced and tested in Ethiopia, herbaceous legume (*Lablab and Vigna ungulatium*) could play a significant role in providing a significant amount and qualified herbages under the smallholder farmers. *Lablab purpureus* one of the herbaceous forage legumes which has been grown in arid, semi-arid and humid regions with rainfalls between 200-2500 mm (Cameron, 1988) and has DM production potential which ranged 3-10t/ha under rain fed condition (Denbela *et al.,* 2015; Cameron, 1988). Conversely, *Vigna ungulatium* is one of the most important forage legume which has been served as source food and feed (Bennett-Lartey and Ofori, 1999) and it could be produced 3.5 – 5.2 t/DM per ha (Denbela *et al.,* 2015). However, in the study area, evaluation the adaptability of these forage legume species under irrigated conditions has not been carried out due to remoteness and mobile nature of pastoralists. Therefore, the study was designed with objectives to identify high yielding improved legume and grass species under irrigated condition.

II. Material and Methods

a) Description of study site

The study was conducted in Dassench Woreda, which is found in South Omo Zone of in SNNP and it is bordered by Kenya in the South, Salamago Woreda in the North and Hammer Woreda in the East. It was lied astronomically (5^0.14'N latitude, 36^0.44'E longitude) and

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225 km from Jinka, the capital city of South Omo Zone. It has high temperature and low annual rainfall, which has ranged from 25-40°C and 350-600 mm respectively with bimodal rainfall and erratic distribution. Altitude of the study area is in the range of 350 - 900m.a.s.l. The most common and dominating soil brand of the area is silt alluvial. The district is highly dominated by short growing woody acacia species and highly grazed and browsed lower altitude area is dominated by *Merea macrenatha.*

b) Trial site and pastoralists

The Keelewe peasant association was selected in collaboration with Woreda pastoral affairs' office experts and Developmental agents after discussion on the objectives of the research activity. One pastoral research group which consisted of twelve household members with three trial pastoralist per pastoralist's research group were selected after community meeting. The criteria for selection of trial pastoralists were availability of land, suitability of site for irrigation, interest pastoralists in research process and irrigation experience of the pastoralist. Finally, training was delivered to Development agents, pastoral research group member, Kebele leaders, and non trial pastoral research members on forage production, irrigation management and benefits of forage productions.

c) Experimental Treatments and Design

The planting materials used for this experiment were the herbaceous forage legume species such as *Lablab intoritum*, *Lablab peruperus* and *Vigna ungulatium*. Completely randomized block design (RCBD) was used with four replications per each tested forage legume species which were arranged in 10 rows of 5m length which have 50cm between rows and 30cm between plants. The supplementary irrigation was used and all plots were irrigated uniformly at six day intervals.

d) Crop management and Data collection

The planted species management activity such as hoeing, weeding, diseases and pest inspection was carried out and trial farms were had been continuously monitored. The yield data such as FBYand DMY were collected from the each tested species at age of eight week after establishment to DM and FBY production potential under irrigated condition in Dassench Woreda. The four samples were randomly taken per tested species at quadrates which has a plot size area 50cm x50 cm = 2500cm^2 by using sickle and transported to Jinka Agriculture research Center and allotted to cut in to small pieces and made pooled it. The representative samples were subjected to oven dried at 105°c for 24hrs at Jinka Agricultural Research Center Animal Feed and Nutrition Laboratory. Then the dry matter yield per each species was calculated by the final weight collected from oven dried was divided by initial weight before the subjecting to the oven dried.

e) Statistical Analysis

Analysis of data was performed using GLM procedure of SAS (Statistical soft ware, 2009). Effect of tested species was considered significantly in all statistical calculation if ($P \leq 0.05$). The least means squares were separated by using Duncan's least significant difference (LSD) test with following model;

$$Y_{ij} = A + \beta_i + t_j + e_{ij}$$

Where: Y_{ij} = Yield parameters measured,
A = General mean of the tested species,
ßi = block effects,
tj = treatment effects and
eij = Random error

III. Result and Discussions

The yield parameters such as FBY and DMY of the tested herbaceous forage legume species under irrigated conditions of Dassench Woreda was illustrated in (Table 1). The least square FBY obtained in this study revealed that there was none significance difference ($P > 0.05$) observed among the tested herbaceous forage legumes in the study area. However, the *Lablab intoritum* had produced relatively better (33t/ha) FBY over *Lablab purpurue* (31.52 t/ha) and *Vagigna ungulatium* (30t/ha).The FBY obtained in this study for *Lablab intoritum* is lower than value (62.20t/ha) reported by Denbela *et al. (*2016) in Woito PAs, in Bena-Tsemay districts under irrigated conditions. Similarly, the FBY obtained in the current study for *Lablab purpureus and Vagigna ungulatium* is also not in agreement to previously reported values by different authors (Denbela *et al*.,2016; Muna et al., 2011; Abusuwar and Al-Solimanin,2013) which ranged 38-51t/ha. Conversely, the DMY obtained in this study revealed that there was none significance difference ($p < 0.05$) among the tested species in the study area. The average DMY production potential of tested forage legume species under irrigated condition in to the Dassench lowland is 15.91, 14.16 and 15.40 t/ha respectively for *Lablab intoritum, Lablab purpureus* and *Vagigna ungulatium*. The finding obtained in this study for *Lablab purpureus* is corroborated to the values that reported by Muna et al.(2011) and Abusuwar & Al-Solimani (2013) which ranged from 12.47-22.24 t/ha under irrigated conditions. However, for the Lablab intoritum, value obtained in this study is lower than what Denbela *et al. (*2016) reported value (23.6t/ha) in Woito PAs, in Bena-Tsemay districts under irrigated conditions. On the other hand, the DMY obtained from the current study for the *Vagigna ungulatium* in irrigated condition is three time higher than what Denbela *et al.*(2015) reported values which ranged from 3.5 – 5.2 t/ha under rain fed condition at Chali and Kako peasant association and Bilatu *et al.(*2012) who reported that DMY released different *Vagigna ungulatium* accessions which was (4.28 t/ha)

at North West lowland area of Ethiopia. However, the encouraging DMY is obtained in this study than what previously Denbela *et al. (*2016) studied value (12.21t/ha) in Woito PAs, in Bena-Tsemay districts under irrigated conditions. In general, the inconsistency in both FBY and DMY of the tested species in this study from previously reported studies, it might be related to difference in tested agro ecology, irrigation management practice, soil fertility and varietal difference (Anele UY. *et al.,* 2011a; Rivas -Vega *et al.,* 2006; Anele UY. *et al. ,* 2011b).

Table1: The Least Square mean of fresh biomass yield of tested improved herbaceous forage species in irrigated lowland of Dassench Woreda in 2014 cropping season

Tested legume species	Yield parameters measured						
	FBY(g/plot)	FBY/ha	CV	LSD	F-value	P- value	SEM
Lablab *intoritum*	823.63[a]	33.00	6.55	20.59	0.02	0.98	NS
Lablab *purpureus*	813[a]	31.52	6.55	20.59	0.02	0.98	NS
Vagigna ungulatium	792[a]	30.68	6.55	20.59	0.02	0.98	NS

FMY = Fresh biomass yield; g = gram; CV = Coefficient of variance; LSD = Least significance difference; SEM = Standard error of mean; NS = Non-significant; ha = hectare

Table 2: The Least Square mean of dry matter biomass yield of tested improved herbaceous forage species in irrigated lowland of Dassench Woreda in 2014 cropping season

Tested legume species	Yield parameters measured						
	DM(g/plot)	DM/ha	CV	LSD	F-value	P- value	SEM
Lablab *intoritum*	395.75[A]	15.91	5.37	14.04	0.01	0.99	NS
Lablab *purpureus*	354[A]	14.16	5.37	14.04	0.01	0.99	NS
Vagigna ungulatium	385[A]	15.40	5.37	14.04	0.01	0.99	NS

FMY = Fresh biomass yield; g = gram; CV = Coefficient of variance; LSD = Least significance difference; SEM = Standard error of mean; NS = Non-significant; ha = hectare

IV. Conclusion and Recommendations

In the current study different improved forage legume species were evaluated for their herbage dry matter yield production potential under irrigated lowland area. Accordingly, *Lablab intoritum* was produced better DMY than *Vagigna ungulatium and Lablab purpureus in that order.* However, the similarity is observed in DMY production potential among the tested species which indicated that the pastoral communities can be used one of the tested species to their vicinity as supplementary feed source in order to mitigate the critical feed shortage especially dry season over the low quality feed(Natural pasture). From the current study on the other hand, it is concluded that better improvement observed in both fresh and dry matter yield of tested species in under irrigated condition than non irrigated condition especially in lowland area which is characterized by high coefficient variability in rainfall distribution patterns. In general, the result reported in the current study is from one cropping season. However, for the forage species fresh and dry matter yields obtained in this study season may be variable in other seasons. Therefore, it is imperative to evaluate the forage species for more seasons under similar agro ecology and addition to their feeding value under different intervention, chemical composition, their response to the disease and pest resistance, seed producing potential and dry matter production potential of species under supplementation different level of fertilizer rate. On the other hand, also it is recommended that the information obtained from this study would benefit the pastoral communities, so the promotion of the tasted species will be demonstrated and scaled out in wider range through pre-scale-up and pre extension demonstrations.

V. Acknowledgments

We are extremely thankful to the Ethiopia Institute of Agricultural Research, Pastoral and Agro pastoral Research and Capacity Building Coordinate Directorate for financial support and Jinka Agricultural Research Center for Research material and vehicle support. Finally, we are grateful acknowledged the Dassench Woreda Agricultural extension developmental agents for their continuous monitoring the experimental site and our pastoralists who donated their land without restraint.

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Table 2: The fresh biomass yield (FBY) and dry matter yield (DMY) and standard error (SE) of *Cenchrus ciliaris, Chloris gayana* and *Pancium colaratum* grown under irrigated lowland of Dassench Woreda in 2014

	Yield parameters measured	
Tested grass species	Fresh weight/g/plot ± Std. Error	Dry matter yield /g/plot ± Std. Error
Chloris *gayana*	1339±141.605[b]	380.2±40.169[a]
Cenchrus *ciliaris*	998±141.605[a]	279.880±40.169[a]
Panicum *colaratum*	1587±141.605[c]	451.987±40.169[b]

Pertaining to the tested grass species the fresh biomass yield (FBY) in this study revealed that there was significance difference ($p < 0.05$) among the tested three grass species. However, on the other hand, there was none significance difference ($p > 0.05$) was observed between *Chloris gayana* and *Cenchrus ciliaris* in terms of the dry matter yield(DMY). Meanwhile, there is significance difference ($p < 0.05$) also in terms of dry matter yield (DMY) between *Panicum colaratum* and *Chloris gayana* and *Panicum colaratum and Cenchrus ciliaris.* The fresh biomass yield (FBY) and dry matter yield (DMY) production potential of tested grass species is 53.56t/ha, 39.92t/ha, 63.48t/ha and 15.21t/ha, 11.20t/ha and 18.08t/ha respectively for the *Chloris gayana, Cenchrus ciliaris* and *Panicum colaratum.* The *Pancium colaratum* produced higher fresh and dry matter yield than *Chloris gayana* and *Cenchrus ciliaris* which is not corroborated to what Denbela (2015) finding (40.8t/ha) on station of Jinka Agricultural Research Center under rain fed condition. This yield difference observed might be effect of irrigation, difference in soil fertility, difference in agro ecologies or farm management effect. Conversely, there was double increments in dry matter yield under irrigation than what Denbela (2015) reported (7.6t/ha) at on station of Jinka Agricultural Research Center and similarly also not corroborated to what Tessema (2008) reported on average 14 t/ha DMY under rain fed conditions in Ethiopia. On the other hand, the fresh biomass yield(FBY) for the *Chloris gayana* in this study corroborated to what Tewdros and Messert (2013) reported that ranged from 31.9-98.0 t/ha for Soddo trial location in Ethiopia and where as dry matter yield (DMY) obtained in this study also corroborated to what Denbela(2015) reported (15 t/ha) at on station of Jinka agricultural Research Center under rain fed condition which is equal to result reported in the current study under irrigation in the study area and similarity in yield it might be irrigation effect played a vital role two different agro ecologies . Moreover, the fresh biomass yield in the current study in *for Cenchrus ciliaris* is also not corroborated to what Denbela(2015) reported (33t/ha) on station of Jinka Agricultural Research Center under rain fed condition. However, the dry matter yield

obtained in the current study for the *Cenchrus ciliaris* not comparable to what Denbela (2015) reported (6.68 t/ha) which attested that there is relatively two time higher dry matter yield under irrigation than rain fed condition at on station of Jinka Agricultural Research Center under rain fed condition and relatively comparable to what Ayana (2010) reported which ranges between 10-16 t/ha under rain fed condition in Ethiopia.

VI. Conclusion and Recommendations

In the current study different improved legume and grass species evaluated for their herbage dry matter yield production potential under irrigated lowland area. Among the improved legume and grass forage species tested, *Vagigna ungulatium* and *Pancium coleratum* produced higher dry matter yield under irrigated condition even though the remaining species performed well .On the other hand, there was variability in both fresh biomass and dry matter among the tested species observed under irrigation when it was compared with yield under rain fed condition. Thus it is might be due to irrigation effect, variability in agro ecologies, variability in soil fertility, variability in management system and variability in species potential. From the current study on the other hand, it is concluded that better improvement observed in both fresh and dry matter yield of tested species in under irrigated condition than non irrigated condition especially in lowland area which is characterized by high coefficient variability in rainfall pattern. In general, the result reported in the current study is from one cropping season. However, for the forage species fresh and dry matter yields obtained in this study season may be variable in other seasons. Therefore, it is imperative to evaluate the forage species for more seasons under similar agro ecology and addition to their feeding value under different intervention, chemical composition, their response to the disease and pest resistance, seed producing potential and dry matter production potential of species under supplementation different level of fertilizer rate. On the other hand, it is recommended that the information obtained from this study would benefit the pastoral communities, so the promotion of the tasted species will be demonstrated and scaled out in wider range through pre-scale-up and scale - out.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

A Survey on the Agricultural Prospects and Potentials of the Niger Delta, in a Post Oil Era

By Uche Chima, Ajie Eunice N. & Familusi I. C.
University of Port Harcourt

Abstract- The Niger Delta of Nigeria has been a very controversial and topical issue in the politics of the nation and in national discusses. In recent times, the region has been witnessing rising agitations, results of years of perceived under development of the region, exploitations of its crude oil resources without due consideration of the degrading effects on the environment and marginalisation of the aborigines. This heightened the call and demand for fiscal federalism as a panacea to these perceptions because many have wondered if the Niger Delta can survive a looming post-oil era of limited revenue, evident under development; and, an agricultural sector that has suffered significant neglect and damage over the years. With a return to the traditional agriculture, the Niger Delta many believe can still retain its pride of place in agriculture among the committee of states in Nigeria given its agricultural potentials. The study therefore focused on the prospects and potentials of the Niger Delta agricultural sector. The researchers adopted a survey plan in their study using a combination of primary and secondary data. Descriptive statistics were used in data analysis where necessary.

Keywords: *niger delta, agriculture, crops, products.*

GJSFR-D Classification: *FOR Code: 079999*

Strictly as per the compliance and regulations of :

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Uche Chima [α], Ajie Eunice N [σ] & Familusi I. C. [ρ]

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Keywords: niger delta, agriculture, crops, products.

I. Introduction/Brief History

The history of Nigeria as a nation to a great extent swings around the Niger Delta. For many centuries, even before the discovery of crude oil, the Niger Delta region has always played prominent role in the fiscal history of Nigeria. Wikipedia (2016) reports that the Niger Delta covers 20,000km^2 within wetlands of 70,000km^2 formed primarily by sediment deposition and home to 20million people of 40 different ethnic groups, making up 7.5% of Nigeria's total land mass and the largest wetland and, the third- largest drainage basin in Africa. The Niger Delta environment has been classified by some scholars into four ecological zones: coastal barrier islands, mangrove swamps, freshwater swamps, and lowland rainforests. The region has sandy ridge barriers along its coasts, rivers, rivulets, streams, mangroves, low land rain forest and numerous creeks.

The Niger Delta Region is inhabited mainly by the minority tribes of Southern Nigeria which comprise of the states of Rivers, Bayelsa, Cross River, Akwa Ibom, Edo and Delta. For political and fiscal convenience and reasons, the region is redefined to include the neighbouring three other oil producing states of Abia, Imo and Ondo. This map may still expand as Lagos and Enugu States have joined the league of oil producing states.

According to Tamuno and Edoumekumo (2012), long before independence, the Niger Delta region has been, to a reasonable extent the fiscal stay of the Nigerian economy, asserting that the Nigerian economy depended on the enormous agricultural potential of the region and was sustained by it from 1558-1855(about 297 years) with palm oil produce before the amalgamation of the Nigerian State.

For some time now, agricultural activities in the Niger Delta have been at very low ebb. This is the resultant consequence of oil exploration in the region, degraded environment and polluted farm lands and waters by oil spills. Ike and Ekanem (2010) have also noted that the massive land taken by the oil companies has diminished the available land for agriculture. Wikipedia (2016) painted another worrisome picture of the Niger Delta land when it reported that the region can experience a loss of 40% of its inhabitable terrain in the next thirty years as a result of extensive dam construction in the region, a visible threat to agriculture. This is Nigeria's Niger Delta.

II. Statement of the Problems

In spite of Nigeria's viability in terms of agricultural activity, Nigeria still imports significant amount of what it can produce locally because of neglect and inconsistent policies in the past. This has put enormous stress on the economy. Presently, the Niger Delta region as an entity risk food shortage, escalating economic tension and significant threat to social harmony induced by avoidable unemployment. The oil, ironically has failed to install the economic boom many initially envisaged. However, according to Ubom, et al (2010), the presence of crude oil and the agricultural potentials of the Niger Delta region suggest the region has economic comparative advantage.

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However, they believe the agrarian communities that make up over 50% of the region have some disadvantage in terms of prospect for agricultural growth and development (caused by apathy to significant agricultural practice, environmental degradation and inconsistent government policies). This portends a bleak future for agriculture which has been the people's primary occupation and culture before the discovery of oil in the region. Azam and Morrison (1999) also share this opinion. Any region in contemporary politically and ethnically polarised Nigeria that is not food-secure, or practice sustainable agriculture is in danger of food sabotage. A significant proportion of the foods eaten in the Niger Delta come from outside the region including fish ironically. In the case of a reverse in oil fortunes which in recent time is becoming a reality, this region may suffer food shortage.

In another consideration, can the Niger Delta be economically self supporting outside the oil and gas resource or survive the imminent post-oil and gas era? In the words of Uduaghan(2013) "The entry of the American shale oil, new crude finds in otherwise fallow regions and the coming of alternative sources of power–green energy, have only helped in complicating matters for the mainstream oil industry". Sooner than later, the demand for fossil fuel may decline significantly, other regions of the nation have reasonable and identified resources outside agriculture yet untapped and unexploited that they can fall on in a post-oil era, what will be the prospect of the Niger Delta then whose agricultural lands have been polluted significantly or, in extreme cases destroyed beyond immediate remediation?

III. Justification for The Study

Tamuno et al (2012) have alerted that analysts have raised alarm that the oil of the Niger Delta region will soon dry up. In the event of this, some have bothered to ask, how can the Niger Delta region forge ahead economically without a visible economic blue print in place at the moment? The Niger Delta nevertheless is endowed with resources outside crude oil which can sustain the region for a significant number of years. These resources include, Lime stone, Manganese, Glass-sand, Kaolin, marble, and Bitumen amongst others. Outside these, the region has good agricultural lands that can support the production of both food and cash crops. All that is needed is development of these resources and exploitation.

The Niger Delta coastal and swampy lands are the most important ecosystems in the world besides being rich in minerals and organic matter that support plant growth (Imogie et al, 2012). Wikipedia (2010) believes this well endowed region contains one of the highest concentrations of biodiversity on the planet in addition to supporting abundant flora and fauna, arable terrain that can sustain a wide variety of crops, lumber or agricultural trees, and more species of freshwater fish than any system in West Africa pointing out that with the PH level of 4.6 to 5.3, the soil is suitable for palm oil, coconut, plantain(in extension bananas), pineapples, and sugar cane production since these crops thrive in acidic soils. The freshwater swamps and there seasonal flooding support the Raphia Palms growth (a novel nectar producing plant). Some major foods crops grow significantly well in the region and include: maize, yam, rice, cassava, sugarcane, pineapples and plantain (Ike and Ekanem, 2010).

It is plausibly obvious, many scholars believe, if the leaders of this region will insist on proper resource management, practical environment remediation and protection, the Niger Delta can enjoy a robust agriculture based economy and become a net exporter of agricultural produce.

IV. Methods and Materials

The study was on a survey of the prospects and potentials of the agricultural sector of the Niger Delta region of Nigeria. The Niger Delta covers 20,000km^2 of wetlands out of 70,000km^2 formed of sediment depositions. This environment is home to 20million people of 40 different ethnic groups. Principally a flood plain, it makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third- largest drainage basin in Africa (Wikipedia, 2016).

This research sourced information through primary and secondary sources. These pieces of information and statistical data spread across the six core Niger delta States. The choice of secondary data became necessary because of so many contemporary researches and data on the agricultural status of the Niger Delta region. The researchers therefore made use of a few secondary data that had no bias reportage. The study and survey focused on the agricultural potentials and produce from the Niger delta as reported by some researchers and evidenced in field survey. Analyses were mostly descriptive.

V. Annual Yields of Documented Food Crops in the Coastal Wetlands of the Niger Delta

The Niger Delta technically, should be the most endowed of the regions in the Nigerian federation in terms of good agricultural land and resources. In the agricultural sector, informed assessment suggests it may be the richest. Its soil is almost the best with rich deltaic deposits that has made the soil very fertile. The soil can effectively support a variety of crops that ordinarily could not grow well in some other parts of the country. All the commercially viable agricultural produce can be effectively produced in the Niger Delta except a few. Even the groundnut has been demonstrated to

grow and produce under good management in the area. The table below is a documentation of the major crops that are grown in the Niger Delta as published by Ike and Ekanem (2016) citing Adedipe(2010). This array of crops is not all inclusive and does not however, include the numerous edible wide forest fruits and vegetables that are yet to be domesticated and commercialised.

Table 1: Mean potential annual yields of food crops in the coastal wetlands of Niger Delta region

Food Crops	Mean yields(metric tonnes/hectare)
Cassava	13.0
Yam	12.1
Cocoyam	5.5
Maize	1.6
Paddy Rice	1.7
Cow pea	0.7
Pepper	1.2
Melon	0.41
Tomatoes	2.8
Okra	0.94
Leafy vegetable	1.04
Plantain	12.3

Source: Adedipe et al, 2010(as reported by Ike and Ekanem, 2016.

It should be noted that this level of output was achieved under traditional and non-mechanized methods of production and mostly unscientific application of inputs. It is also observed that most farmers here seldom use fertilizers which are very common in some regions of Nigeria. Scholars suggest the region can produce significant amount of what Nigeria consumes under good and modern practices and management. Unfortunately however, some researchers have reported deficits in the quantum of output because of neglect, focus on petroleum and inconsistent government agricultural policies. The table suggest the region can be a viable agricultural zone in a post-oil era if supportive policies are enacted and the damage inflicted on the environment through oil exploration and exploitation are remediated and early enough. Other food/vegetable crops produced in the Niger Delta but not mentioned by Ike & Ekanem (2016) include; water melon, cucumber, onions, garlic, pineapples, potatoes, cocoyam, bananas, cabbage and soya beans amongst others however, on a subsistence scale as observed in the field and few research farms.

VI. Documented Output Deficits of Major Food Crops in the Niger Delta

Evidences of food insecurity in contemporary Niger Delta are apparent. Olaniyi (2011), states that food security is physical and economic access to adequate food by households without the risk of losing the access. Citing FAO documentary, Olaniyi(2016) commented that food security exists when people have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy life. The supply of food or food availability in this region is practically inadequate especially from indigenous sources. This is evident on the very high prices of the available ones which many believe is the effect of demand pressure. Every form of food supply deficit or shortage denotes food insecurity. Physical and economic access to adequate food is eluding many households because of limited supply of foods. Production apathy presently witnessed requires concerted efforts in both public and private sectors to reverse. Below is a table culled from Adedipe et al (2010) as reported by Ike and Ekanem(2016) revealing the extent of deficit in the production of food crops that can be produced in the region. The statistical report covering 2010 is shown in table 2 below.

Table 2 : Estimated yield and demand for some food crops in the coastal wetlands of the Niger Delta region in 2010

Crops	Supply/MT	Demand/MT	Deficit/MT
Cassava	14,897	24,413	-9516
Maize	1,774	4,602	-2,828
Yam	12,462	24,475	-12,013
Plantain	3,385	8,473	-5,788
Vegetable	7,766	13,554	-5,788
Fruits	8,752	14,839	-6,087

Source: Adedipe et al, 2010(as reported by Ike and Ekanem, 2016)

Mechanized agriculture is not a very common feature in most Niger Delta farms. Subsistent agriculture is still the norm and mostly practiced in the rural areas under conditions of significant drudgery , also visible is the neglect by both the government and individuals hence, the production deficits with respect to demand. Also, some areas in the Niger Delta region have been witnessing reasonable influx of people because of the presence of the multi-national oil companies; this has put pressure on the limited farm produce with no option than to import what could be locally produced. This could be remedied by agriculture friendly policies and the development of commercial and mechanized farms. Information accessed through the Agricultural Development Programme(ADP) of the ministry of agriculture, Rivers State of 2013 and 2014 farming season vindicates the perceptions of informed minds about the state of the agricultural sector in the region and shown in the tables below.

Table 3: Estimates of Output of selected crops in metric tonnes in the south-south zone(Niger Delta) of Nigeria in 2013/2014 production season

Crops	2013 Output	2014 Output	% Change
MAIZE	872.0	925.2	6.09
RICE	509.3	567.6	11.45
GINGER	0.0	0.0	0.0
YAM	7512.8	8351.3	6.61
GROUNDNUT	19.8	22.9	3.10
MILLET	0.0	0.0	0.0
CASSAVA	12166.4	12167.3	0.008
COWPEA	88.7	93.1	4.89
COCOYAM	709.3	710.5	0.17
SOYBEAN	0.0	0.0	0.0
OKRA	1229.3	1229.3	0.0
TOMATO	43.7	44.0	0.3

Source: Agricultural Development Programme, Rivers State, 2016

A critical view of the table shows that even among the crops produced in the region, deficits still exist in output of the crops. Except in the production of cassava, production level is still lagging behind with respect to demand as shown in table 2. All that will be required is right policies and discriminatory attention in favour of the agricultural sector.

VII. Cash Crops Grown in the Niger Delta Agriculture

According to Wikipedia (2016), a cash crop is grown for sale to return a profit. It is typically purchased by parties separate from the producer. They are most often grown for export and monetary gain rather than for domestic consumption. The Niger Delta is naturally endowed with numerous cash crops whose optimum exploitation could turn the regions fortunes around. The table below shows an array of cash crops grown in the Niger Delta region of Nigeria and there economic uses.

Table 4: Cash Crops of the Niger Delta Region

Cash Crop	Derivatives/Uses
Oil Palm	Palm oil, palm kernel oil, animal feed, palm wine, fibre
Rubber	Latex
Cocoa	Cocoa bean powder, beverages, wine
Raphia Palm	Palm wine, fibre
Cashew	Cashew nut, fruit juices
Ground Nut	Edible oil, ground nut cake, animal feed
Coconut	Oil, juices
Ginger	Spices

Source: field observation, 2016.

a) Oil Palm

According to Ike and Ekanem(2016), the soil type and weather conditions in the Niger Delta support oil palm production and also ranks as one of the highest producers of oil palm and oil palm products in Nigeria. Both wild and hybrid species exist and are sources of different subsidiary products. From their statistical estimates, the wild population is put at 600,000 hectares of land and hybrid/plantation species 37,000 hectares in 1980. They state that palm oil was a predominant feature that successfully boosted the economy of Nigeria at a time. History records that Nigeria was a leading nation in oil palm and palm oil production. Surprisingly, Nigeria now is lowly rated in palm oil production been overtaken by Malaysia, a country that obtained her seedlings from Nigerian. Today, Malaysia is a world leading producer of palm oil (Nigerian observer, 2016). According to Tamuno et al(2012), the Niger Delta's 9 states produce about 57% of total Nigerian palm oil production made up largely of collection of palm fruit from wild groves (74% of area and about 50% of supply), this they say is augmented by production from private plantations (small, medium and large farmers, 19% of area and 34% of supply of fruit) and large corporate and government owned plantations (about 7% of area 25% supply of fruits).

b) Raphia palm

The raphia palm, a novel plant to many is a tree crop that is mostly found in Rivers, Bayelsa and Akwa Ibom States largely and grows mostly in fresh water swamps. The raphia palm has social and economic value to the people of the Niger Delta. Some products of the Raphia palm include palm wine, raphia fibre, bamboo poles for building amongst others (Ike & Ekanem, 2016). This novel crop can be developed further under well articulated agricultural policies for its exotic wine which is good beverage. With a significant amount of the Niger Delta land mass been fresh water swamps, this region under good management may be in for a monopoly that may positively impact her economy since the raphia palm is largely found in this area.

c) Rubber

Significantly, the Midwest region was noted for its rubber plantation and was quite a huge success as the crop played its role as a major economic plant (Nigerian Observer, 2016). The rubber plant is one of the principal ingredients in the manufacture of tyres and other rubber based products.

d) Cocoa

According to the Nigerian Observer (2016), in the 1960s, each region of the country was noted for the production of some cash crops in commercial quantities. The South Western region was popular for cocoa production for export and the proceeds from cocoa contributed immensely to the infrastructural and economic development of the region. The Niger Delta fortunately can produce cocoa conveniently. In reality, there are several small cocoa farms in several smallholdings in the region. The features for

commercialization are favourable. All that is needed is a policy statement and the framework to actualize it.

e) Coconut

Wikipedia (2016) has reported that coconuts are known for their great versatility, evidenced by many traditional uses, ranging from food to cosmetics. It constitutes part of the diet of many people and beginning to make its way into the fruit juice industry for its delicious nectar. The coconut palm is grown in the Niger Delta for its many culinary and medicinal uses. Every part of the coconut palm is useful and of economic value. Dotting the coasts of this region are coconut trees growing in the wild. In many communities are different domesticated (agric) species of exotic qualities. What had stopped the commercialization of this economic crop remains an issue of debate.

f) Cashew

Apart from being a cash crop, cashew also has health benefits. It is surprising though that most people are ignorant of these health benefits (Okpala, 2016). Like coconut, this plant is one of the condiments of many exotic fruit juices. In this region, they grow luxuriantly even in the wild. Observations show that little has been done to tap this resource and reap its dividends.

g) Ginger

Ginger is prominent in many cuisines and food menus of this region, its production is still very insignificant and the ones consumed are imported from outside the region largely. Ginger has been a famed crop for centuries in the world and still in high demand. Ironically, despite its luxuriant growth in this region little is done to produce it except in experimental or school farms. Ginger is an export material that has a reasonable demand worldwide.

h) Groundnut

Also called peanut is a crop of high economic importance. Largely grown in the northern part of Nigeria, also does well in the Delta region. However, its production is limited to few areas on a subsistent scale. While its production in the region is not considered an issue remains a debatable factor.

VIII. Fruits of the Niger Delta Agriculture

According to Foraminifera (2016), Fruits are natural staple food of man, containing essential nutrients in adequate proportion and excellent sources of minerals, vitamins and enzymes. Easily digested and have cleansing effects on the blood and body. Outside being a source of food, fruits also serve as medicine. A large percent of fruits consumed in the globe come from the tropics. The Niger delta has a conducive climate for fruits to thrive and produce in significant proportion and remains one of Nigeria's most conducive environments for some of the most popular fruits in the country – citrus, pineapples, bananas, mangoes, cashew, pawpaw and many others. Despite the regions huge potential in fruits production for the population, a lot are imported from outside the region. What is lacking is the ability to process these and turn them into job creating industries. However, in spite of these potentials very few large scale fruits and vegetable processing industries are operational in the Niger Delta.

Some wild berries and fruit bearing trees are never considered as economic in most discusses here, however, they are novel areas to be explored and exploited. The beverage and soft drink industries know the importance of this array of fruits. For now, there is no available large scale production of these fruits except the pineapple and the recent Songhai farm and banana plantation established by the Rivers State government. Informed minds believe that incidences of militancy and youth restiveness in this region are unemployment induced and could be tackled through the development of the agricultural sector such as this. Is the unemployment situation in this region self inflicted? Some researchers believe so considering the volume of agricultural resources at the disposal of the region yet to be developed and exploited. Fruits juice production is a viable project as raw materials are readily available in every part of Niger Delta. Raw materials for fruits juice are oranges, lime, lemon, pawpaw, guava, pineapple, mangoes, etc. These grow with relative ease in most Niger Delta regions and waste away during the production season. There is every assurance that any production plant installed here will work round the year as constant supply of raw materials (fruits) is guaranteed. Iwuoha (2016) has made a strong case on the importance of developing the fruit juice industry, stating that each year, Nigeria imports orange concentrates worth over US$140 million for local fruit juice production and intimates that global market for fruit and vegetable juices is growing fast and is forecast to exceed 70 billion litres by the year 2017. He confirmed that there is a rising preference by individuals for healthy drinks (like fruit juices) over soft drinks and also a rising demand for organic, super fruit and 100 percent natural fruit juices without any sweeteners and preservatives. The table below shows the array of fruits that grow naturally in the region.

Table 4: Fruits of the Niger Delta

Fruits	Derivatives
Oranges	Juices, Eaten raw as snack,
Mangoes	Juices, Eaten raw as snack
Pawpaw	Juices, Eaten raw as snack
African Star Apple	Eaten raw as snack
Sour Sop	Juices, Eaten raw as snack,
Bread Fruit	Delicacy(porridge), snack
Bush Mango	Eaten raw as snack, soup thickener
Plum	Juices, Eaten raw as snack
Tangerine	Juices, Eaten raw as snack
Lime	Juices, Eaten raw as snack
Peach	Juices, Eaten raw as snack
African Pear	Eaten as snack
Grapes	Juices, Eaten raw as snack
Guava	Juices, Eaten raw as snack,
Pineapple	Juices, Eaten raw as snack
Banana	Juices, Eaten raw as snack,
Avocado	Eaten raw as snack
Cashew	Juices, Eaten raw as snacks

Source: field observation, 2016.

The information gathered so far shows the Niger Delta has enormous potentials yet unexploited. The result portrays the region as a domain for fruit trees. This implies many agro-based industries may not lack raw materials should this sector of the agricultural industry be developed and mass production encouraged. The juice producing industries in particular may not lack raw materials if the sector engages in large scale production and commercialisation. In addition to this, the springing up of subsidiary firms to service these industries will generate so many jobs for the teeming idle hands. African countries like South Africa make up to 6 billion Rand (nearly $600 million) every year from fresh citrus fruits exported to the USA and Europe. Because these fruits are a very rich source of vitamin C, they are also used in pharmaceutical industries to make dietary supplements (.Iwuoha, 2016).

IX. Conclusion

The perceived agricultural limitations in the Niger Delta region are self inflicted a consequence of poor leadership and inconsistent policies. The presence of crude oil in the region is a visible distraction that may have plagued the region for years. The agricultural environment is good and can support several crops not presently considered for cultivation by individuals and corporate organizations. Expert opinions suggest the region can adequately produce enough to feed the country and even export (the study did not exhaustively detail all the crops produced in the region but only pointed to the ones that are considered popular with reasonable demand.). The study also, did not consider the livestock sectors which have been showing considerable progress of late. The region will luxuriantly survive a post oil era if, the right policies are put in place and things are done right.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

The Mean Performance of Different Bread Wheat (*Triticum Aestivum.* L) Genotypes in Gurage Zone, Ethiopia

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Abstract- In Ethiopia, a number of improved bread wheat *(TriticumaestivumL.)* varieties have been released by different research centers inorder to see the adaptability and performance of different bread wheat genotypes. However nothing has been done at Gurage Zone and therefore a total of twenty five bread wheat *(TriticumaestivumL.)* genotypes were evaluated for adaptability and performance at Gurage zone at two different environments. The genotypes were grown in randomized complete block design. Data were collected on 13 agronomic characters. Based on the mean separation, highest grain yield (4941.70kg/ha) was recorded from Hoggana, while lowest yield of (1983.30 kg/ha) was obtained from Kakaba and Sofumar at Fereziye. At Kotergedra, the highest grain yield of (5366.7 kg/ha) was also recorded from Hoggana and the lowest yield of (3166.7 kg/ha) was obtained from Kakaba. The highest above ground biomass also obtained from Hoggana at both location 10850.00 kg/ha and 16992.00 kg/ha at Fereziye and Kotergedra respectively. Statistically, the variety Hoggana gave the highest tillers per plant and spikes per plant at both locations those are positive contributions to grain yield.

Keywords: *bread wheat, triticum aestivum, mean.*

GJSFR-D Classification: *FOR Code: 300399*

Strictly as per the compliance and regulations of :

The Mean Performance of Different Bread Wheat (*Triticum Aestivum.* L) Genotypes in Gurage Zone, Ethiopia

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Abstract- In Ethiopia, a number of improved bread wheat *(TriticumaestivumL.)* varieties have been released by different research centers inorder to see the adaptability and performance of different bread wheat genotypes. However nothing has been done at Gurage Zone and therefore a total of twenty five bread wheat *(TriticumaestivumL.)* genotypes were evaluated for adaptability and performance at Gurage zone at two different environments. The genotypes were grown in randomized complete block design. Data were collected on 13 agronomic characters. Based on the mean separation, highest grain yield (4941.70kg/ha) was recorded from Hoggana, while lowest yield of (1983.30 kg/ha) was obtained from Kakaba and Sofumar at Fereziye. At Kotergedra, the highest grain yield of (5366.7 kg/ha) was also recorded from Hoggana and the lowest yield of (3166.7 kg/ha) was obtained from Kakaba. The highest above ground biomass also obtained from Hoggana at both location 10850.00 kg/ha and 16992.00 kg/ha at Fereziye and Kotergedra respectively. Statistically, the variety Hoggana gave the highest tillers per plant and spikes per plant at both locations those are positive contributions to grain yield. Therefore, the genotypes can be considered when increment of these characters was needed. Therefore genotype Hoggana could be used for the seed system program in the respective location.

Keywords: bread wheat, triticum aestivum, mean.

I. Introduction

Wheat, a self-pollinating annual plant in the true grass family *Gramineae (Poaceae)*, is extensively grown as staple food sources in the world [5]. It is exclusively produced under rain fed conditions, *meher* and *belg* (long and short rainy seasons), respectively. The genetic origin of wheat is of interest; since it is a classic example of how closely related species may be combined in nature into a polyploid series. The species of *Triticum* (*T.*) and their close relatives can be divided into diploid, tetraploid and hexaploid groups, with chromosome numbers of 2n = 14, 28 and 42, respectively, in which the basic chromosome number of wheat is x = 7. *Triticum durum* originated thousands of years ago from a hybridization between the wild diploid *T. monococcum* L. (A genome donor) and the donor of the B genome which, according to morphological, geographical and cytological evidence, has been recognized as *T. speltoides* (Tausch) Gren or a closely related species [1].

Wheat is grown at an altitude ranging from 1500 to 3000 m.a.s.l, between 6-16^0 N latitude and 35-42^0 E longitude in our country. The most suitable agro-ecological zones, however, fall between 1900 and 2700 m.a.s.l [1]. Wheat in Ethiopia is an important cereal crop and it ranks fourth in total area coverage next to teff, maize and sorghum; also fourth in total production next to maize, teff and sorghum. 4.23 million tons of wheat is produced on an area of 1.7 million ha and about 4.6 million farmers were involved. Oromia, Amhara, SNNP and Tigray are the major wheat producing regions in the country with area coverage of 875641.45, 529609.63, 137294.72 and 108865.39 ha respectively. Furthermore, 47259 farmers were involved with unestimated area coverage in Gurage Zone in 2015 main production season [3].

In Ethiopia, bread wheat improvement has started in 1949 and up to now many varieties have been released by the national and regional research institutes. However, those varieties are not widely distributed to all parts of the country. This is because of several constraints including the remoteness and in accessibilities of the growing areas that limited to test the adaptability and yields of the varieties in such areas. It is necessary to evaluate varieties for the intended growing regions since varieties were recommended as high yielding after evaluating at few representative wheat growing areas, in other words the varieties were not evaluated in all wheat growing regions. At Gurage Zone of South Nation, Nationality region is one of the areas where improved varieties are not widely distributed so far, most probably due to the above indicated problems. Particularly, the potential of the area to wheat crop is not exploited due to lack of improved varieties, there is no detail information indicating the adaptability and production status of the improved bread wheat varieties in the area. Since it provides information that can be utilized to improve wheat yield through breeding and to

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identify high yielding and more adaptable varieties to improve productivity and production of wheat. In view of the above limitation, the present study was undertaken with the following specific objectives:

1. To see the adaptability and performance of different bread wheat verities in the studied area.

II. Materials and Methods

a) Experimental Materials

Experimental materials comprised of twenty five bread wheat genotypes released from different agricultural research centers (Table 1).

Table 1: List of Genotypes

Entry	Variety Name	Source Center	Year of Release
1	ETBW 5879	Kulumsa	2014
2	ETBW 6095	Kulumsa	2014
3	WORRAKATTA/PASTOR	Sinana	2014
4	UTQUE96/3/PYN/BAU//MILLAN	Sinana	2014
5	Hidasse	Kulumsa	2012
6	Ogolcho	Kulumsa	2012
7	Hoggana	Kulumsa	2011
8	Hulluka	Kulumsa	2012
9	Mekelle-3	Mekelle	2012
10	Mekelle-4	Mekelle	2013
11	Shorima	Kulumsa	2011
12	Mekelle-1	Mekelle	2012
13	Mekelle-2	Mekelle	2011
14	Ga'ambo	Werer	2011
15	Kakaba	Kulumsa	2010
16	Danda'a	Kulumsa	2010
17	Gassay	Adet	2007
18	Alidoro	Holleta	2007
19	Digelu	Kulumsa	2005
20	Tay	Adet	2005
21	Sofumar	Sinana	1999
22	Mada-Wolabu	Sinana	1999
23	Pavon-76	Kulumsa	1982
24	Jefferson	Kulumsa	2012
25	King Bird	Kulumsa	2014

b) Experimental Design and Field Management

The genotypes were planted in early July 2015 at Wolkite University stations (Kotergedra and Fereziye) (Table 2). The genotypes were grown in randomized complete block design (RCBD) with three replications. Each plot consisted of six rows spaced 20cm X 2.5m long. The plot area was $3m^2$ (2.5m X 1.2m). A 1.5 meter distance was maintained between replication and 50cm between plots used for both sites.

Fertilizers (both N and P_2O_5) was applied at the rate of 150 kg/ha urea and 100 kg/ha DAP at the time of planting and tillering. Seeding was done at the rate of 125Kg/ha. Seed and fertilizer was drilled uniformly by hand. Weeding and other agronomic practice was carried out as per recommendations of the respective sites.

Table 2: Location and descriptions of weather conditions for the two testing sites

Sites	Seasonal Temperature (°C)		Soil type	Soil PH	Seasonal Rainfall (mm)	Location		
	Max	Min				Latitude	Longtiude	Altitude
Fereziye	24.37	10.2	EutricNitisols	5.4	1336.8	8.2^0N	37.9^0E	1980 masl
Kotergedra	23	8	EutricNitisols	5.7	1450	8.05^0N	37.5^0E	2600 masl

c) Data collection

The data on the following attributes was collected on the basis of the central four rows in each plot.

1. *Days to heading (DTH):* The number of days from date of sowing to the stage where 75% of the spikes have fully emerged.
2. *Days to maturity (DTM):* The number of days from sowing to the stage when 90% of the plants in a plot have reached physiological maturity.
3. *Grain filling period (GFP):* The number of days from heading to maturity, i.e. the number of days to maturity minus the number of days to heading.

4. *Grain yield (GY):* Grain yield in grams obtained from the central four rows of each plot and converted to kilograms per hectare at 12.5% moisture content.
5. *1000-kernel weight (TKW):* Weight of 1000 seeds in gram.
6. *Above ground biomass (AGB):* The plants within the four central rows were harvested and weighed in grams.
7. *Harvest index (HI):* On a plot basis, the ratio of dried grain weight to the dried above ground biomass weight multiplied by 100.

Ten plants were randomly selected from the four central rows for recording the following observations:

1. Tillers/plant (TPP): The average number of tillers
2. Plant height (PHT): The average height in cm from ground level to the tip of the spike.
3. Kernels per spike (KPS): The average number of kernels per spike.
4. Spikelet per spike (SkPS): The average number of spikelet's per spike.
5. Spike length (SL): The average spike length in cm from its base to the tip.
6. Spikes per plant (SPP): The average number fertile spikes per plant including tillers.

d) Data Analysis

The data were recorded were subjected to analysis by using General Linear Model procedure and the statistical package SAS version 9.1 was used for the following statistical procedures.

e) Analysis of variance

The analysis of variance was conducted using randomized complete block design (RCBD). Before computing the combined analysis, error variance homogeneity test was performed using the procedure suggested by [4]. In the combined analysis of variance, locations were considered random and genotypes were considered fixed. The least significant difference (LSD) was used to compare two means at the 5% and 1% level of significance.

Analysis of variance of randomized complete block design for each test location was computed using the following mathematical model:

$$Yij = \mu + rj + gi + \varepsilon ij$$

Where: Y_{ij} =the observed value of the trait Y for the i^{th} genotype in j^{th} replication
μ= the general mean of trait Y
rj = the effect of j^{th} replication
gi= the effect of i^{th}genotypes and
εij= the experimental error associated with the trait y for the i^{th}genotype in j^{th}replication.

Analysis of variance of randomized complete block design for combined location was computed using the following mathematical model:

$$Yijk = \mu + gi + Ej + GEij + Bk(j) + \varepsilon ijk$$

Where: $Yijk$= observed value ofgenotype $_i$ in block $_k$ of location $_j$
μ= grand mean
Gi= effect of genotype $_i$
Ej= environment or location effect
$GEij$= the interaction effect of genotype$_i$ with location/environment $_j$
$Bk(j)$= effect of block k in location/environment $_j$
εijk = random error or residual effect of genotype$_i$in block $_k$ of location $_j$

Least significant Difference (LSD) among genotypes and coefficient of variation in percent (CV %) for all characters was computed [4].

$$LSD = \alpha\ (2\sigma^2 e/r)^{½}$$

CV%= $[(\sigma^2 e)^{½} / \bar{x}) \times 100]$ where, α = t- value at 5% and 1% probability level.

III. Results and Discussion

a) Range and Mean of Different Characters

Estimated range, mean, coefficient of variation and list significant difference the mean are presented in Tables 3, 4 and 5 for Fereziye, Kotergedra and combined locations respectively. Wide ranges were recorded for most traits at Fereziye. Based on the mean separation, highest grain yield (4941.70kg/ha) was recorded from Hoggana, while lowest yield of (1983.30 kg/ha) was obtained from Kakaba and Sofumar at Fereziye. At Kotergedra, the highest grain yield of (5366.7 kg/ha) was also recorded from Hoggana and the lowest yield of (3166.7 kg/ha) was obtained from Kakaba. The highest above ground biomass also obtained from Hoggana at both location 10850.00 kg/ha and 16992.00 kg/ha at Fereziye and Kotergedra respectively.

Most of the genotypes headed and matured earlier at Fereziye than at Kotergedra due to the lower altitude and high temperature. The mean days to maturity of 115.8 with the range of 101.00-135.00 for Fereziye and 148.69 with the range of 142.67-156.00 for Kotergedra. Related range was obtained from the finding of [6]. Based on the mean separation, variety Digelu and Kakaba were late and early matured genotypes respectively at Fereziye. Moreover, Digelu, Alidoro and Pavon-76 had late whereas Kakaba had early matured genotypes at Kotergedra. The mean days to heading of 65.53 with the range of 53.00-75.33 at Fereziye and 79.21 with the range of 76.00-85.00 at Kotergedra. Alidoro, Tay and Hogana had late whereas Kakaba had early headed genotypes at Fereziye. ETBW

6095 and Pavon-76 had late and early headed genotypes at Kotergedra.

Higher mean plant height (66.4 cm) with range of 54.70-82.57 was recorded at Fereziye. At Kotergedra, mean plant height was shorter (56.25 cm) with the range of 46.00-66.83. Alidoro was the highest plant height from the genotypes at both locations. The grand mean for grain yield (3742.33 kg/ha) and biological yield (11922.00 kg/ha) were recorded at Kotergedra and (2941.00 kg/ha) and (8281.00 kg/ha) that were recorded at Fereziye. Related grain yield range was reported by [2].

At Kotergedra, mean grain filling period was 69.48 with the range of 64.33-78.00 and 50.27 with the range of 40.00-61.33 for Fereziye. Genotypes Millan and pavon-76 had early grain filling periods whereas Digelu had late grain filling period at Fereziye. Pastor and Pavon-76 had early and late grain filling period respectively at Kotergedra. At Fereziye the mean 1000 kernel weight was 43.53 with the range of 35.00-50.00 and 44.00 with the range of 33.33-53.33 was recorded at Kotergedra. The mean tiller per plant (7.73) with the range of 5.03-12.83 was recorded at Fereziye and (7.88) with the range of 5.40-10.43 was recorded at Kotergdra. Therefore wide ranges were recorded for most studied characters at Fereziye than Kotergedra.

At Fereziye the mean number of kernel per spike (47.92) with the range of 35.83-66.00, the mean number of spikelet per spike (16.50) with the range of 13.53-21.30, the mean spike length (8.61) with the range of 6.73-11.30 and the mean number of spike per plant (6.69) with the range of 4.03-11.83 were recorded. However, the mean number of kernel per spike (53.11) with the range of 44.17-70.60, the mean number of spikelet per spike (16.51) with the range of 14.20-21.40, the mean spike length (8.44) with the range of 6.87-10.07 and the mean number of spike per plant (6.75) with the range of 5.30-10.27 was recorded at Kotergedra. Some related range and mean was found from [6]. Statistically, the variety Hoggana gave the highest tillers per plant and spikes per plant at both locations those are positive contributions to grain yield. Therefore, the genotypes can be considered when increment of these characters was needed.

Across allocation (Table 5), the mean days to heading (72.37) with the range of 64.67-78.17, the mean days to maturity (132.25) with the range of 122.17-145.67, the mean grain filling period (59.87) with the range of 53.67-69.50 were recorded. The mean 1000 kernel weight (43.77) with the range of 34.17-51.67, the mean above ground biomass (10101.60) with the range of 7487.5-13920.8 was recorded across allocation. Moreover, the mean tillers per plant (7.40) with the range of 5.62-11.63, the mean plant height (61.33) with the range of 50.93-74.70 were recorded. The mean spikelet per spike (16.50) with the range of 13.87-21.35, the mean spike length (8.52) with the range of 6.85-10.45 and the mean spikes per plant (7.15) with the range of 5.98-9.18 were recorded across allocation.

Table 3: Mean performance of 25 bread wheat genotypes for the 13 characters tested at Fereziye

Genotype	DTH	DTM	GFP	GY	TKW	AGB	HI	TPP	PHT	KPS	SKPS	SL	SPP
ETBW 5879	67.00	113.00	46.00	3066.70	46.67	8716.70	0.36	7.10	61.20	43.23	15.77	7.80	6.10
ETBW 6095	60.00	109.00	49.00	2300.00	46.67	7258.30	0.32	5.87	62.70	47.00	15.13	8.87	4.87
WORRAKATTA/PASTOR	62.33	111.00	48.67	2966.70	40.00	8791.70	0.34	7.80	58.33	50.23	14.60	7.10	6.80
UTQUE96/3/PYN/BAU//MILLAN	67.00	109.67	42.67	3091.70	41.67	9291.70	0.33	8.27	71.23	40.30	15.83	9.40	7.27
Hidasse	57.67	109.00	51.33	2316.70	43.33	6191.70	0.38	5.03	60.80	49.00	16.10	8.03	4.03
Ogolcho	71.67	121.33	49.67	2833.30	46.67	7916.70	0.36	6.83	71.83	49.87	16.47	9.57	5.83
Hoggana	75.33	130.33	55.00	4941.70	45.00	10850.00	0.47	12.83	72.03	49.33	17.97	9.10	11.83
Hulluka	67.00	122.00	55.00	4033.30	41.67	12508.30	0.32	9.97	66.30	50.10	16.47	8.40	8.97
Mekelle-3	60.00	103.67	43.67	2566.70	41.67	8316.70	0.31	7.13	67.13	41.87	15.93	8.00	6.30
Mekelle-4	71.33	121.00	49.67	3825.00	43.33	10291.70	0.38	9.13	61.03	49.30	16.77	9.33	8.13
Shorima	67.00	113.67	46.67	3083.30	43.33	8600.00	0.36	8.23	67.47	44.33	16.37	9.17	7.23
Mekelle-1	57.67	112.67	55.00	2633.30	41.67	7141.70	0.37	5.57	63.03	53.50	15.73	8.77	4.57
Mekelle-2	62.33	109.00	46.67	3883.30	45.00	9775.00	0.40	8.07	67.23	57.00	17.13	9.23	7.07
Ga'ambo	67.00	107.00	40.00	3116.70	45.00	8091.70	0.39	6.80	65.90	46.63	15.20	8.27	5.80
Kakaba	53.00	101.67	48.67	1983.30	45.00	4858.30	0.42	5.07	54.70	38.80	13.53	7.70	4.10
Danda'a	73.67	134.33	60.67	2208.30	50.00	5691.70	0.42	6.67	65.43	58.17	17.47	8.17	5.67
Gassay	67.00	122.00	55.00	3150.00	45.00	10316.70	0.31	8.43	68.63	48.97	17.47	8.40	7.13
Alidoro	74.00	130.67	56.67	3908.30	45.00	10941.70	0.36	9.37	82.57	66.00	21.30	11.30	7.97
Digelu	74.00	135.33	61.33	3150.00	36.67	10400.00	0.30	11.33	78.00	55.63	17.33	6.73	9.97
Tay	74.00	128.00	54.00	2858.30	41.67	9500.00	0.30	8.87	72.50	57.30	19.17	9.23	7.87
Sofumar	62.33	109.00	46.67	1983.30	45.00	5608.30	0.36	5.73	69.23	35.83	17.13	8.43	4.73
Mada-Wolabu	67.00	123.00	56.00	2625.00	50.00	7041.70	0.37	7.83	65.97	43.60	16.50	9.43	6.83
Pavon-76	62.33	105.00	42.67	2250.00	43.33	6841.70	0.33	7.07	65.40	37.13	15.30	8.30	6.07
Jefferson	53.00	101.00	48.00	2066.70	40.00	5558.30	0.37	6.10	59.93	39.53	16.03	8.33	5.10
King Bird	64.67	112.67	48.00	2683.30	35.00	6530.00	0.41	8.07	61.50	45.37	15.90	8.07	7.07
Mean	65.53	115.80	50.27	2941.00	43.53	8281.20	0.36	7.73	66.40	47.92	16.50	8.61	6.69
CV %	3.46	4.30	9.55	7.99	6.33	11.93	14.59	11.79	4.89	17.63	5.80	6.04	14.24
LSD 0.01	4.97	10.91	10.51	514.47	6.03	2164.40	0.12	2.00	7.11	18.50	2.10	1.14	2.09
0.05	5.33	8.17	7.88	385.66	4.52	1622.50	0.09	1.50	5.33	13.87	1.57	0.85	1.56

Where: DTH= Days to heading, DTM= Days to maturity, GFP= Grain filling period, GY= Grain yield, TKW= Thousand kernel Weight, AGB= Above ground biomass, HI= Harvest index, TPP= Tillers per plant, PHT= Plant height, KPS= Kernel per spike, SKPS= Spikelet per spike, SL= Spike length, SPP= Spike per plant, CV= coefficient of variation and LSD=least significant

Table 4: Mean performance of 25 bread wheat genotypes for the 13 characters tested at Kotergedra.

Genotype	DTH	DTM	GFP	GY	TKW	AGB	HI	TPP	PHT	KPS	SKPS	SL	SPP
ETBW 5879	81.00	147.67	66.67	3483.30	45.00	10425.00	0.34	7.30	55.83	48.90	15.70	8.30	7.23
ETBW 6095	85.00	150.00	65.00	3433.30	45.00	9842.00	0.35	8.07	53.20	51.97	15.77	8.73	7.53
WORRAKATTA/PASTOR	82.67	147.00	64.33	3466.70	41.67	10150.00	0.34	6.73	51.00	51.57	14.93	8.47	6.67
UTQUE96/3/PYN/BAU//MILLAN	79.00	143.67	64.67	3816.70	41.67	12275.00	0.31	7.77	59.83	45.63	15.77	8.20	7.00
Hidasse	80.00	151.00	71.00	3500.00	43.33	10542.00	0.33	6.20	53.13	52.60	15.67	7.80	5.30
Ogolcho	79.00	151.00	72.00	3916.70	46.67	13375.00	0.29	7.70	62.10	55.60	16.63	8.63	7.27
Hoggana	79.33	144.33	65.00	5366.70	45.00	16992.00	0.32	10.43	63.13	57.33	18.43	8.77	10.27
Hulluka	78.33	144.33	66.00	3758.30	43.33	12442.00	0.30	9.17	54.17	51.93	16.23	7.87	8.87
Mekelle-3	80.33	146.33	66.00	3541.70	41.67	11133.00	0.32	6.53	46.00	46.30	16.03	7.13	5.67
Mekelle-4	77.00	148.67	71.67	3941.70	45.00	12817.00	0.31	7.00	51.50	58.47	16.77	9.17	6.10
Shorima	77.67	151.00	73.33	3600.00	43.33	11983.00	0.30	6.73	59.47	51.13	16.07	9.23	6.83
Mekelle-1	77.67	149.33	71.67	3633.30	41.67	12650.00	0.29	7.53	55.87	55.20	16.27	8.83	6.67
Mekelle-2	78.33	146.00	67.67	4166.70	45.00	13592.00	0.31	7.00	53.27	59.37	17.00	8.13	6.93
Ga'ambo	79.00	147.67	68.67	3708.30	45.00	11550.00	0.32	7.13	58.87	50.43	15.47	8.03	6.67
Kakaba	76.33	142.67	66.33	3166.70	45.00	10117.00	0.31	6.43	47.17	44.17	14.20	7.23	6.13
Danda'a	78.33	152.33	74.00	3608.30	46.67	12167.00	0.30	6.03	62.47	59.40	16.87	9.07	5.90
Gassay	77.33	149.33	72.00	4258.30	46.67	13600.00	0.31	6.73	58.90	57.27	17.17	9.80	7.03
Alidoro	82.33	156.00	73.67	4266.70	45.00	13775.00	0.31	7.37	66.83	70.60	21.40	9.60	7.03
Digelu	78.33	156.00	77.67	3616.70	40.00	11367.00	0.32	6.90	59.73	59.77	16.60	6.97	6.83
Tay	81.00	147.67	66.67	3708.30	41.67	11642.00	0.32	6.47	61.37	58.80	18.37	9.67	6.30
Sofumar	79.33	145.33	66.00	3458.30	46.67	10283.00	0.34	7.07	54.07	49.83	16.80	8.60	6.50
Mada-Wolabu	80.67	151.67	71.00	3575.00	53.33	10467.00	0.34	5.40	56.07	50.20	16.53	10.07	5.77
Pavon-76	76.00	154.00	78.00	3750.00	43.33	13433.00	0.28	7.07	57.47	48.40	15.63	7.47	6.40
Jefferson	80.00	145.00	65.00	3500.00	45.00	10917.00	0.32	5.90	51.13	45.47	16.17	6.87	5.73
King Bird	76.33	149.33	73.00	3316.70	33.33	10517.00	0.32	6.33	53.73	47.30	16.17	8.30	6.23
mean	79.21	148.69	69.48	3742.33	44	11922	0.32	7.08	56.25	53.11	16.51	8.44	6.75
CV%	4.01	2.16	6.07	11.16	6.45	12.50	7.50	15.43	6.82	6.05	6.07	7.97	14.14
LSD 0.01	6.96	7.04	9.23	914.78	6.21	3262.60	0.05	2.39	8.40	7.04	2.19	1.47	2.09
0.05	5.22	5.28	6.92	685.74	4.66	2445.70	0.04	1.79	6.30	5.28	1.64	1.10	1.57

Where: DTH= Days to heading, DTM= Days to maturity, GFP= Grain filling period, GY= Grain yield, TKW= Thousand kernel weight, AGB= Above ground biomass, HI= Harvest index, TPP= Tillers per plant, PHT= Plant height, KPS= kernel per spike, SKPS= Spikelet per spike, SL= Spike length, SPP= Spike per plant, CV= coefficient of variation and LSD=least significant difference

Table 5: Combined mean performance of 25 bread wheat genotypes for the 10 characters

Genotype	DTH	DTM	GFP	TKW	AGB	TPP	PHT	SKPS	SL	SPP
ETBW 5879	74.00	130.33	56.33	45.83	9570.80	7.20	58.52	15.73	8.05	7.02
ETBW 6095	72.50	129.50	57.00	45.83	8550.00	6.97	57.95	15.45	8.80	7.70
WORRAKATTA/PASTOR	72.50	129.00	56.50	40.83	9470.80	7.27	54.67	14.77	7.78	6.38
UTQUE96/3/PYN/BAU//MILLAN	73.00	126.67	53.67	41.67	10783.30	8.02	65.53	15.80	8.80	7.70
Hidasse	68.83	130.00	61.17	43.33	8366.70	5.62	56.97	15.88	7.92	6.17
Ogolcho	75.33	136.17	60.83	46.67	10645.80	7.27	66.97	16.55	9.10	7.92
Hoggana	77.33	137.33	60.00	45.00	13920.80	11.63	67.58	18.20	8.93	9.18
Hulluka	72.67	133.17	60.50	42.50	12475.00	9.57	60.23	16.35	8.13	8.13
Mekelle-3	70.17	125.00	54.83	41.67	9725.00	6.83	56.57	15.98	7.57	6.25
Mekelle-4	74.17	134.83	60.67	44.17	11554.20	8.07	56.27	16.77	9.25	7.22
Shorima	72.33	132.33	60.00	43.33	10291.70	7.48	63.47	16.22	9.20	7.50
Mekelle-1	67.67	131.00	63.33	41.67	9895.80	6.55	59.45	16.00	8.80	7.22
Mekelle-2	70.33	127.50	57.17	45.00	11683.30	7.53	60.25	17.07	8.68	7.58
Ga'ambo	73.00	127.33	54.33	45.00	9820.80	6.97	62.38	15.33	8.15	6.97
Kakaba	64.67	122.17	57.50	45.00	7487.50	5.75	50.93	13.87	7.47	5.98
Danda'a	76.00	143.33	67.33	48.33	8929.20	6.35	63.95	17.17	8.62	6.53
Gassay	72.17	135.67	63.50	45.83	11958.30	7.58	63.77	17.32	9.10	7.22
Alidoro	78.17	143.33	65.17	45.00	12358.30	8.37	74.70	21.35	10.45	8.12
Digelu	76.17	145.67	69.50	38.33	10883.30	9.12	68.87	16.97	6.85	6.58
Tay	77.50	137.83	60.33	41.67	10570.80	7.67	66.93	18.77	9.45	7.27
Sofumar	70.83	127.17	56.33	45.83	7945.80	6.40	61.65	16.97	8.52	6.97
Mada-Wolabu	73.83	137.33	63.50	51.67	8754.20	6.62	61.02	16.52	9.75	7.10
Pavon-76	69.17	129.50	60.33	43.33	10137.50	7.07	61.43	15.47	7.88	6.85
Jefferson	66.50	123.00	56.50	42.50	8237.50	6.00	55.53	16.10	7.60	6.53
King Bird	70.50	131.00	60.50	34.17	8523.30	7.20	57.62	16.03	8.18	6.65
Mean	72.37	132.25	59.87	43.77	10101.6	7.4	61.33	16.5	8.52	7.15
CV %	3.86	3.14	7.55	6.33	12.43	13.69	5.77	5.88	7.08	12.36
LSD 0.01	4.23	6.29	6.85	4.20	1903.7	1.53	5.36	1.47	0.91	1.34
0.05	3.19	4.75	5.17	3.17	1438.1	1.16	4.05	1.12	0.69	1.10

Where: DTH= Days to heading, DTM= Days to maturity, GFP= Grain filling period, TKW= Thousand kernel weight, AGB= Above ground biomass, TPP= Tillers per plant, PHT= Plant height, SKPS= Spikelet per spike, SL= Spike length, SPP= Spike per plant, CV=Coefficient of variation and and LSD=Least Significant Difference

IV. Conclusions

This study generally indicated that there is an opportunity in selection of superior varieties among advanced bread wheat genotypes through direct selection at the study locations as short term strategy rather than a lengthy crossing program. Genotypes, Hoggana, Hulluka, Alidoro, Mekelle 2 and Mekelle 4 at Fereziye and Hoggana, Alidoro, Gassay, Mekelle 2, Mekelle 4, Ogolcho and Millan at Kotergedra are well performed genotypes. From these genotypes Hoggana can be used for wheat production and seed system program at both locations.

Abbreviation

CSA	Central Statistical Agency
RCBD	Randomized Complete Block Design
SAS	Statistical Analysis System
SNNP	South Nation, Nationality and People

V. Acknowledgement

First I would like to thank Ethiopian Ministry of Education for financial support and Haramaya University for hosting the study. I am grateful to Wolkite University for giving me the opportunity to use research field, allocating the required labor, materials for field work and vehicle for the research field supervision.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Evaluation of Dry Nursery Management in Semi-Arid and Arid Areas of Daro Labu and Habro Districts, West Hararghe Zone, Oromia, Ethiopia

By Desalegn Mamo, Alemayhu Diriba & Shimelis Dekeba
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Abstract- The success of plantation program depends to a great extent on success of nursery. Nursery usually, depending on weather condition and bed type. Beds can be made of three types (raised bed, sunken bed and level bed. To this end, we have been undertaken the experiment on evaluation of dry nursery management at arid and semi arid areas in Daro Labu and Habro districts in randomized complete block design with six replications (PAs as replication) in 2013/14 and 2014/15 cropping seasons. Coffee (Mehara-1) variety was sown as test crop in sunken bed with different treatments (bare root without plastic sheet, bare root with plastic sheet, polythene tube without plastic sheet and polythene tube with plastic sheet) and normal bed (level bed) as control.

Keywords: *dry nursery, percentage, survival rate, root-shoot ratio.*

GJSFR-D Classification: *FOR Code: 070199*

Strictly as per the compliance and regulations of :

Evaluation of Dry Nursery Management in Semi-Arid and Arid Areas of Daro Labu and Habro Districts, West Hararghe Zone, Oromia, Ethiopia

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Abstract- The success of plantation program depends to a great extent on success of nursery. Nursery usually, depending on weather condition and bed type. Beds can be made of three types (raised bed, sunken bed and level bed. To this end, we have been undertaken the experiment on evaluation of dry nursery management at arid and semi arid areas in Daro Labu and Habro districts in randomized complete block design with six replications (PAs as replication) in 2013/14 and 2014/15 cropping seasons. Coffee (Mehara-1) variety was sown as test crop in sunken bed with different treatments (bare root without plastic sheet, bare root with plastic sheet, polythene tube without plastic sheet and polythene tube with plastic sheet) and normal bed (level bed) as control. Two years data of survival rate, root-shoot ratio, and seedling height and germination percentage were collected and analyzed. The result revealed that there was significant difference ($P<0.05$) in survival rate during first and second years in which bare root without plastic sheet, polythene tube without plastic sheet and control shown higher performance than bare root with plastic sheet and polythene tube with plastic sheet. Bare root without plastic sheet and polythene tube without plastic sheet offers much promise for nursery management for future use in arid and semi-arid areas of the study areas and similar agro-ecologies.

Keywords: dry nursery, percentage, survival rate, root-shoot ratio.

I. Introduction

The most extensive dry woodland types in eastern Africa are in the semi-arid zone, covering 1.6 million km2 (Timberlake *et al.* 2010). Climate Change will further exacerbate the situation in the region, and species that will be more vulnerable are those with: limited geographical range and drought/heat intolerant; low germination rates; low survival rate of seedlings; and limited seed dispersal/migration capabilities (Chidumayo 2008, Chidumayo *et al.* 2011).

Despite the existence of enormous genetic diversity of coffee and its importance in the national economy of Ethiopia, the per unit area national average yield of the crop is hardly exceeds 0.7 ton ha-1 clean coffee (Central Statistical Authority, 2012). This low productivity of the crop stems from a sundry of reasons. *Inter alia,* use of twisted, forked and whippy seedlings with undesirable shoot and root growth for field planting and erroneous management of the plant during the nursery period are the major constraints which accounts for low coffee yield in the country. These emanate from use of growing media not suitable for germination and seedling growth, improper depth of seed sowing and inadequate or excessive shading and watering during the nursery period (Anteneh *et al*., 2008).

Arid and semi-arid environments are generally very fragile. These lands are associated with low and unreliable rainfall and relatively high temperature. The best example is districts found in west Hararghe zone where about 70% of land lies in these environments (Farming system of Daro Labu and Boke districts, Mechara agricultural research center (unpublished)); thus resulting in limited water resources and difficulty for establishment of seedling and other farming system.

Nursery practices must be consistent and the various techniques closely integrated. If one element in the chain is lacking there will be a negative impact on seedling quality. Good quality seedlings cannot be produced and sustain without care. Nursery plants need to be protected from extremes of environmental conditions until they are strong enough to withstand.

The nursery industry continues to develop new production methods that encourage the growth of more fibrous roots, preserve more roots at transplanting time, improving root circling in production beds, and prevent root mortality due to thermal heat loading (Appleton, 1995, 1994 and 1993). Nurseries usually depend on weather condition and bed type. Beds can be made of three types (raised bed, sunken bed and level bed). Based on irrigation facility and in the nursery, raised beds are used in areas with high water tables, sunken ones are used in semi-arid and arid areas while flat beds are used in intermediate areas(Anonymous,1996).

Dry nursery is a nursery maintained without any irrigation or artificial watering like in underground seed bed (sunken bed). Such beds can easily resist the drought with its underground moisture conservation, during dry season. It is also in dry regions, especially on sandy soils with low water-holding capacity, vegetables can be planted in sunken beds. Sunken beds were laid out 30 to 50cm deep from the ground level in order to collect run-off water from adjoining areas and reduce

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evaporation loss from the sides and conserve water much more effectively than raised beds for two reasons. First, it don't have the exposed sides as raised beds from where considerable moisture can be lost by evaporation, and second none of the applied water is lost by runoff (Luna, 2006).

According to Anonymous (1996), the nature of the bed affects the conditions for survival rate and other growth parameters. Preparation of sunken bed could be with plastic sheet under the floor base of beds; this system could be used for controlling root growth penetrating in to the ground and save water for seedlings, if moisture availability was good at the first sowing time. This mechanism assumes that water intake of plant/day was saved as compared to normal earthen bed and water requirement of seedlings could be reduced. The objective of conducting this field trial is, therefore, to select the best seed bed type that can sustain seedling in dry period during summer, especially for arid and semi-arid areas of districts in West Hararghe Zone and other similar agro-ecologies

II. Materials and Method

a) Description of the study area

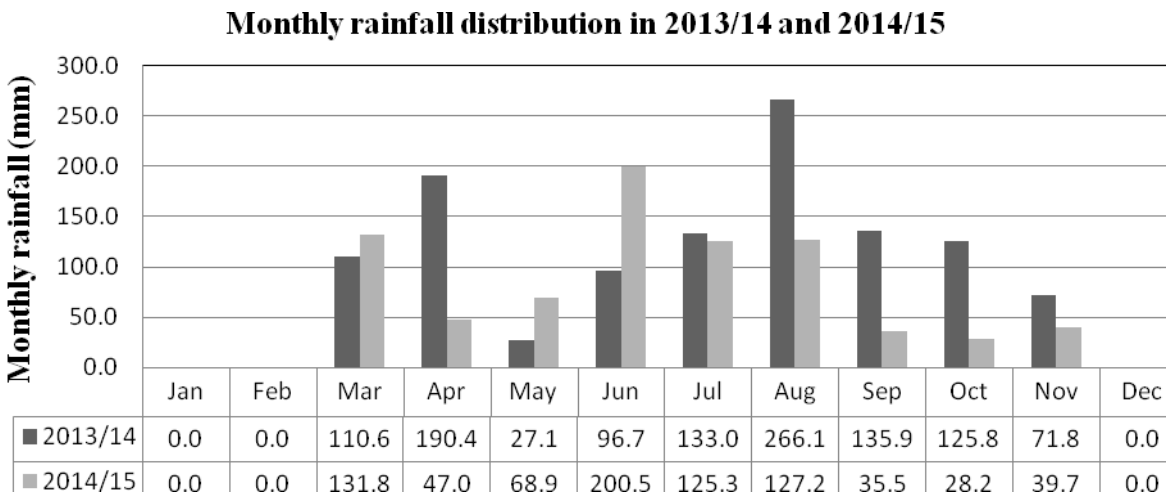
The study was undertaken in West Harargе zone, Habro and Daro Labu districts that are located to South of Chiro town, the capital of the zone, at a distance of 70 and 110 km respectively. The altitude range for Daro Labu is 1350 to 2450 m.a.s.l with area coverage of 434,280 ha whereas that of Habro district varied between 1464 to 2450 m.a.s.l with total area of 730.32 square kilometers (CSA, 2005). Their latitudinal and longitudinal positions are 40^{0}19.114 East and 08^{0}35.589 N for Daro Labu district and 8^{o}36.06'North latitude and 40^{o}20'.76''East longitude for that of Habro district. Both districts have bimodal type of rain fall distribution with average annual rainfall of 1094mm and mean annual temperature 20^{o}C summarized from Mechara metrological station for Daro Labu district and that of Habro district is 1,010mm annual rainfall with mean annual temperature of 18.5^{o}C.

The nature of rainfall in the area is very erratic and often unpredictable causing tremendous erosion. The predominant production systems in the districts are mixed crop-livestock production. The crops grown in the area includes food crops like teff, maize, sorghum, pulses as well cash crops such as coffee and chat. Mango, Avocado and Citruses are also grown to some extent. The major soil type of the area is Nitisol and its texture is sandy loam clay which is reddish in color particularly in Daro Labu district (Report on farming system of Daro Labu and Boke districts, Mechara agricultural research center (unpublished)). Nitisol in lowland part and Vertisol in mid-land is the major soil type found in Habro district. Exactly three Peasant associations that were more or less found at the same level of altitude from each district were selected to conduct the trial (Table 1).

Table 1: Peasant associations where nursery is established in DaroLabu and Habro districts in 2013 & 2014

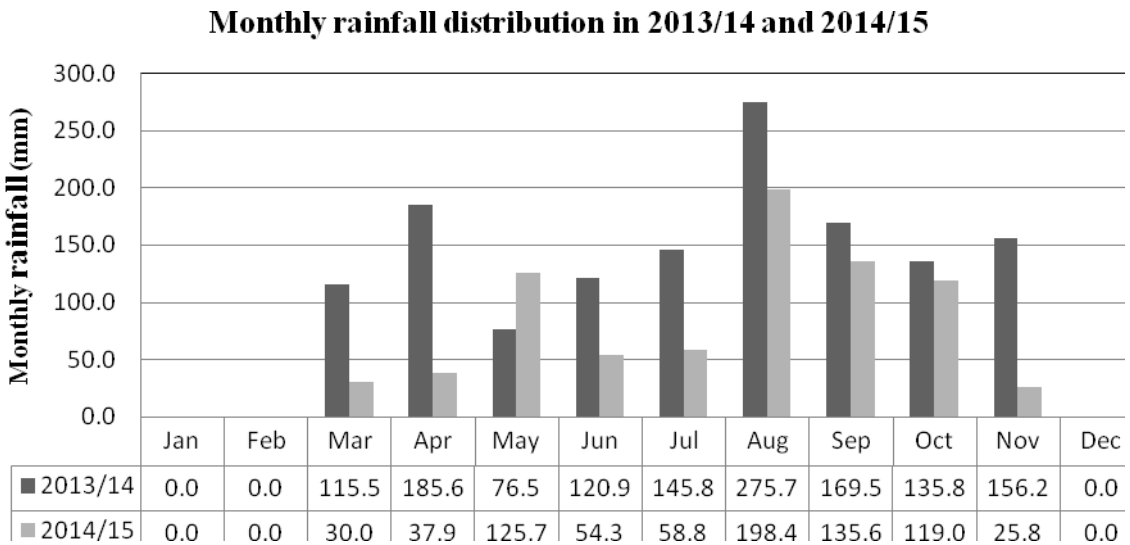
SN	District	Peasant associations	Distance from capital town	Altitude
1	DaroLabu	Burakisa	14 km from Mechara town	1633 m.a.s.l
		Haroresa-qile	23 km ,,	1635 ,,
		Sakina	25 km ,,	1668 ,,
2	Habro	Gerbigoba	3 km from Gelemso town	1703 ,,
		Lagabera	5 km ,,	1707 ,,
		Ibsa	15 km ,,	1701 ,,

The monthly rainfall pattern in 2013/14 and 2014/15 cropping season taken at Mechara (Daro Labu) and Gelemso (Habro) stations is depicted in Figure 1 & 2 below. The rainfall amount in the second year (2014/15) is recorded low as compared to the first one which has impact on seedling survival and other growth indicators.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013/14	0.0	0.0	110.6	190.4	27.1	96.7	133.0	266.1	135.9	125.8	71.8	0.0
2014/15	0.0	0.0	131.8	47.0	68.9	200.5	125.3	127.2	35.5	28.2	39.7	0.0

Figure 1: Monthly rainfall distribution in 2013/14 and 2014/15 at Mechara station



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013/14	0.0	0.0	115.5	185.6	76.5	120.9	145.8	275.7	169.5	135.8	156.2	0.0
2014/15	0.0	0.0	30.0	37.9	125.7	54.3	58.8	198.4	135.6	119.0	25.8	0.0

Figure 2: Monthly rainfall distribution in 2013/14 and 2014/15 at Gelemso station

b) Experimental design and layout

The experiment design was randomized complete block design with six replications (peasant associations were used as replication). Sunken bed was prepared below the general level of the path, because the level path would facilitate underground moisture and it is beneficial in dry soil and well drained localities (Luna, 2006). The sizes of sunken beds were 6m length x1m width x 30 cm depth. The underground plastic sheet had the size of 80cm width and 2.6m length. For bare root, in both sunken beds with plastic sheet and without plastic sheet the soil was refilled to the length of polyethylene tube (22cm). As a control, Level bed of the same size as of sunken beds was laid in east west directions above ground. The seeds of coffee variety (Mechara-1) were direct sown on prepared seed bed in all treatments before on set of rainy season.

Treatments (Sunken bed had four treatments + Level bed as control):

1. Sunken bed with underground plastic sheet + polythene tube
2. Sunken bed with underground plastic sheet + bare root
3. Sunken bed without underground plastic sheet + polythene tube
4. Sunken bed without underground plastic sheet +bare root
5. Level bed (control)

Figure 3: Sunken bed preparation of dry nursery management at Daro Labu and Habro districts

c) Data collection and analysis

Data for germination percentage, survival rate, root-shoot ratio and seedling length were collected. Germination percentage was analysed as the proportion of germinated seeds to total number of sown seeds, where as survival rate was analysed as the proportion of surviving seedling to germinated seeds. Root-shoot ratio was analysed as the ratio of root to shoot and seedling length is the total length of surviving seedling.

Plot means for four variables were calculated to two decimal places and analysis of variance (ANOVA) was performed by stastical analysis (SAS in GLM). Treatment comparisons of means were made at alpha 0.05 siginificance level using Least Siginificant Difference (LSD) test .

III. Results and Discussion

The statistical analysis reveal that there were no significant difference in germination percentage, root-shoot ratio and seedling length during 1stand 2nd years while, there were significant difference in survival rate in 1st and 2nd years in which bare root without plastic sheet, polythene tube without plastic sheet in sunken bed and level bed (control) shown higher performance over the other treatments.

The study revealed that during the first year all treatments give less than one root-shoot ratio which means shoot growth exceeds root growth and in the second year, root-shoot ratio greater than one for bare root without plastic sheet, polythene tube without plastic sheet and control signifying root growth exceeds shoot growth due to shortage of moisture occurred in that year. The result is in line with the study conducted by Niklas (1994) and Hunt and Nicholls (1986) that; root-shoot ratio increase in dry period (roots grow more as compared to shoot to search moisture to enhance survival of the seedlings). Besides, seedling length measured for level bed (15.67cm), bare root without plastic sheet (17.50cm) and polythene tube without plastic sheet (16.83cm) in sunken bed are in line with standard seedling length of 15-40cm for out-planting particularly in first planting year. But in the second year it didn't reach standard size due to drought (Table 2).

Table 2: Mean germination percentage, Survival rate, root-shoot ratio and seedling length at Habro and Daro Labu districts in 2013/14 and 2014/15 cropping seasons

Means in 2013/14 and 2014/15 cropping seasons								
Treatment	Germination %		Survival rate (%)		Root to shoot ratio (cm/cm)		Seedling length (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	77.67b	49	71.91ab	44.79a	0.83	1.50	15.67	10.84
Bare root without plastic sheet in sunken bed	85.67ab	69	86.98a	77.25a	0.78	1.53	17.50	12.75
Polythene tube without plastic sheet in sunken bed	84.33ab	57.5	84.09a	66.27a	0.85	1.73	16.83	11.54
Bare root with plastic sheet in sunken bed	90.00a	54.5	50.64b	0b	0.54	-	13.00	-
Polythene tube with plastic sheet in sunken bed	88.00ab	53	49.75b	0b	0.56	-	12.50	-
CV (%)	10.79	32.79	36.62	69.99	50.67	34.47	35.24	11.20
LSD (5%)	11.07	28.59	30.29	40.616	0.43		6.41	
P-value	0.22	0.62	0.043	0.0027	0.4	0.53	0.39	0.49

IV. Conclusion and Recommendations

Since survival and growth characteristics of seedlings at their early growth is highly affected by environmental conditions that are prevailing in arid and semi-arid areas like in most districts of West Hararghe zone, which results from low and erratic rain fall pattern and have limited/no irrigation water sources, use of appropriate nursery management is necessary. Dry nursery management is among available options in the area. The result from the study confirmed that use of sunken bed without lining with plastic sheet and sowing seed bare root or with polythene tube increased survival and other growth characteristics of coffee seedlings. Thus, bare root without plastic sheet and polythene tube without plastic sheet could be used to survive seedlings in dry areas.

V. Acknowledgment

The authors thanks to Wezir Mohamed for his participation on establishment of the trail and data collection, Habro and Daro Labu Agricultural office for participation in the establishment of the trial and the Oromia Agricultural Research Institute for financial support.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effects of Different Feed Supplements on Nutrient Intake, Body Weight Gain and Economic Feasibility of Grazing Abera Sheep

By Meseret Tsegaye Tegegne
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Abstract- The study was carried out in Darra district of Abera Gelede village in Abera sheep type improvement substation with the aims of investigating the effects of supplementing concentrate and urea molasses feed block /UMB/ on intake and body weight gain of grazing Abera sheep. Thirty two yearling male Abera sheep with mean initial body weight of 21.93 ± 0.23 kg (mean ±SE) were taken from six Abera sheep improvement member co-operatives. The experiment was conducted using a complete randomized block design with four treatment diets and eight replications. The sheep were blocked based on their initial body weight into eight blocks and each of the four treatment diets were randomly assigned to each animal in each block. Dietary treatments comprised of T(1)= grazing control; T(2), wheat bran 66 %: noug seed cake 33 % and 1% salt; T(3), wheat bran 66 %: cotton seed cake 33 % and 1% salt, and (T4), urea molasses feed - block (wheat bran 25%, molasses 36%, cement 10%, noug seed cake 13%, urea 10%, salt 3% and limestone 3%).

Keywords: *abera sheep, supplementation, weight gain; urea molasses feed- block.*

GJSFR-D Classification: *FOR Code: 070199*

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Keywords: abera sheep, supplementation, weight gain; urea molasses feed- block.

I. Introduction

Sheep production in Ethiopia plays a very important role in contributing to the food security, domestic meat consumption and generating cash income as well as providing continuous service to the economic stability of smallholder farmers (Alemu Yami & R. C. merkel, 2008). Smallholder farmers depend on sheep for much of their livelihood, often largely than on cattle (ESGPIP,2008). Sheep serve as a bank account which can be drawn upon when cash money is needed. These sheep represent only 7% of the average total capital invested in livestock, but they account on average for 40% of the cash income and 19% of the total value of subsistence food derived from all livestock production (Hirpa and Abebe, 2008). Sheep also contributes 21% of the total ruminant livestock meat output of the country (Sebsbie, 2008).

Short-term intensive feeding prior to sale is economically more feasible than the current systems where animals are kept for long periods of time on maintenance level feeding. Because of decline in grazing lands and low productivity of animals, coupled with irregular pattern of rainfall, grazing with supplementation is nowadays adopted by the farmers in sheep production. Shortage of feed and fodder and their poor nutritive value could be tackled to some extent by way of supplementation (ESGPIP, 2008). Urea Molasses Mineral Block (UMMB) is made by combining urea, molasses and minerals in a form that can be used for feeding of animals and it has been used successfully in cattle and small ruminants (Forsberg *et al*., 2002). Mineral deficiency in grazing ruminants has been reported by several authors (Gowda *et al.*, 2004 and Khan *et al*., 2007).

Cost benefit analyses of short term fattening compared to maintenance feeding for extended periods show that short term fattening can be a viable business venture for small scale farmers in Ethiopia (ESGPIP, 2008). The goal of any feeding program is to provide the correct amount and balance of nutrients to animals at proper time to achieve the desired level of performance and profitability (Adugna, 2008). Therefore, this experiment was conducted to improve feed intake and body weight gain of Abera sheep supplementation of different types of concentrate mixes and urea molasses feed block.

II. Materials and Methods

a) Study area

The study was, conducted at community based Abera sheep improvement substation in Sidama Zone, Southern Ethiopia; one of the mandated woredas of Hawassa agricultural research center, Abera Gelede

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village. It is 100 km from capital of SNNPRS, Hawassa city. Hawassa, is located at 275 km south of the city of Addis Ababa. Sidama zone is currently divided in to 19 *woredas* in which each *woreda* on average has a population of 100,000 (CSA, 2007). Agro-ecology of the *woreda* includes 30.35% Kolla, 54.54% *Woynadega* and 15.13% *Dega*. Altitude of the *woreda* ranges from 1400-2800 m.a.s.l. Mean annual temperature is 27°c (BOARD, 2011).

b) Experimental animals and their management

Intact yearling Aberra sheep type with mean body weight of 21.93 ± 0.23 kg were taken from six co-operatives involved in community based sheep improvement and the sheep /ram/ which was not selected for breeding purpose was used for the feeding experiment. The age of the sheep was determined by recorded data from Darra sheep breed improvement substation. During the adaptation period, animals were Dewormed with a broad spectrum anti-helemantic (Albendazole) against internal parasites. The animals were penned individually in well ventilated pens (1.5 m × 90 cm × 1.10 m) with concrete floors and had access to feeding and watering trough. Pen cleaning has taken every morning after feed supplement offered and the sheep allow for grazing. The house is made of corrugated iron roof. The experiment was carried out from December 4, 2015 to March 2, 2016.

c) Feeds Experimental feed and feeding

The experimental feeds were formulated at required level and purchased from Sidama Elto Union/ Hawassa, feed processing center/. The concentrate supplements were composed of (wheat bran, noug seed cake/ cotton seed cake, salt) and urea molasses feed block composed of (wheat bran, noug seed cake, urea, molasses, salt, limestone and cement). The basal diet, natural grass, grazed for 7 hr. Daily body weight gain were calculated by the difference between final and initial body weight divided by the feeding days.

Table 1: Experimental Treatments

Ingredient	Treatment diet			
	T 1	T 2	T3	T4
Natural pasture	Grazing	Grazing	Grazing	Grazing
Molasses	-	0	0	36
Urea	-	0	0	10
Wheat bran	-	66	66	25
Cotton seed cake	-	0	33	0
Noug seed cake	-	33	0	13
Salt	-	1	1	3
Cement	-	0	0	10
Lime stone	-	0	0	3
Total	-	100	100	100

T1= grazing , T2= grazing, 66% wheat bran, 33 Noug seed cake, 1% salt, T3=grazing ,66% wheat bran, 33 cotton seed cake, 1% salt, T4= grazing , UMB /wheat bran 25%, noug seed cake 13%, salt 3%, limestone 3%, molasses 36% urea 10% and cement 10%/

d) Experimental Design

The experimental design used was a complete randomized block design (CRBD) with four treatments and eight replications. Based on their initial body weight, thirty two sheep were blocked into eight. Each of the four treatment diets was randomly assigned to each animal in each block. The treatment diets consists of supplementing different types of concentrate and urea molasses block on DM basis in sheep fed on grazing natural grass as a basal diet.

e) Feeding Trial

The feeding trial lasted for 90 days following an acclimatization period of 14 days to the experimental pens and treatment diets. Three hundred gram concentrate supplement and 100 gram UMB was given once a day at 8:00 AM (0%) and (maximum 25%) refusal, respectively. Grazing was limited for 7hr. clean drinking water was provided all the time. Daily feed offered and the refusal was weighed for each animal and recorded throughout the trial period to determine the amount of feed consumed as a difference between that offered and refused. Representative samples were then taken for the feed offered every morning before feeding, dried, ground and placed in air tight container until it was taken for analysis. Treatment refusals were pooled and sub-sampled for analysis. The daily average feed intake was estimated by the difference between the amounts of feed offered less the amount of feed refused on DM basis. Body weight of each sheep was recorded every 14 days after overnight fasting to determine body weight change. Average daily weight gain was calculated as the difference between final body weight and initial body weight of the sheep divided by the number of feeding days.

f) Chemical analysis of the feed samples

The DM content of feed offered and refusal was determined by the standard methods of the Association of Official Analytical Chemists (AOAC, 1990) and ash

was determined by igniting the sample in muffles furnace at 550 0C for 3 hrs (AOAC, 1990). Total nitrogen (N) content of the feed was determined using Micro-Kjeldahl method. The crude protein content was calculated as N* 6.25. Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) content were determined according to Van Soest et al. (1991) using in an ANKOM® 200 Fiber Analyzer (ANKOM Technology Corp., Fairport, NY, USA).

g) Statistical analysis

Data on feed intake and body weight gain were analyzed using the General Linear model (GLM) procedure of the statistical analysis system (SPSS). Duncan Multiple Range test was used for comparison of mean differences between treatments. The model used for data analysis was Yij= μ + Ti + Bj + eij where Yij= response variable (feed intake and body weight gain); μ = overall mean; Ti = the fixed effect of diet; Bj = the block effect; eij = random error. Results are presented as least square means with their standard errors of mean SEM.

h) Partial Budget Analysis

Partial budget analysis was performed to evaluate the profitability of sheep fed a basal diet of natural grass supplemented with concentrate diet and UMB which was considering the main cost component. Experienced animal dealers estimated the selling price of each sheep at the end of the experiment. Economic analysis was done by using partial budget analysis. The price of concentrate feed mix, UMB, buying and selling prices of animals; price of natural grass and labor cost were recorded and used for the analysis. The partial budget analysis was employed using the procedure of Upton (1979). The purchasing and selling price difference of sheep in each treatment before and after the experiment was considered as total return (TR) in the analysis. The net income (NI) was calculated by subtracting total variable cost (TVC) from the total return (TR). NI = TR-TVC Marginal revenue MR = NI / TVC.

III. Results

a) Chemical Composition of Experimental Feed

Table 2: Chemical compositions of experimental feed and treatment diets

Feed Items	Nutrients							
	DM	OM	CP (6.25*N)	NDF	ADF	Ca	P	ME cal /kg
Natural grass	96.80	88.73	9.78	65.59	47.02	-	-	-
T2	93.62	93.83	19.62	39.27	32.42	0.34	1.16	2.44
T3	97.84	94.26	19.06	38.90	26.25	0.19	1.30	2.57
T4	97.48	80.02	27.46	19.43	2.57	6.82	0.48	1.93

DM= Dry matter, CP= Crude protein, NDF= Nutral detergent fiber, ADF= Acid detergent fiber. Laboratory analysis was worked at Hawassa University Animal Nutrition Laboratory Result

The chemical composition of the natural grazing grass and the three treatment diets was not significantly different in their DM and OM content. But there was significant difference on the CP, NDF, ADF and energy contents of the concentrate supplement T2 and T3 and the basal diet natural grass. But there was a difference in CP content of natural grass; it has lower crude protein than T2, T3 and T4. Fiber analysis indicates that/ UMB/Urea molasses block contain lower NDF (19.43) and ADF (2.57) than the two treatments T2 and T3.

b) Feed intake

Table 3: The mean daily DM (dry matter) and nutrients intakes of sheep fed concentrate mixture and UMB

Intake	Treatments				SL
DM	*T1	T2	T3	T4	
Concentrate	-	269.46±3.86	288.50±3.86	0	NS
UMB	-	0	0	73.11±10.93[a]	*
OM	-	253.97±4.23	279.75±4.23	58.5±11.96	*
CP	-	53.64±1.2	62.81±1.2	20.1±3.39	*
NDF	-	106.66±1.97	120.05±1.97	14.21±5.58	*
ADF	-	86.05±0.82	83.55±0.82	2.33± 1.88	*

*T1= grazing for all treatments a basal diet and control. NS= Non significant, * Significant*

The average voluntary feed intake by sheep fed on the three different treatment diets given above in the Table3. The Dry matter intake /DMI/ in T2 (269.46 g/day/h) and T3 (288.50g/day/h) has significant

differences (P<0.05) than T4 (73.11g/day). T4 intake value was similar to those reported by Ibrahim (1991). The higher DMI on both T2 and T3 improves OMI /organic matter intake/CPI, and NDFI by the animals. Concentrate was acceptable by the animals and that shows no refusal in T2 and T3, but there was on average 25 gm urea molasses feed block refusal from the expected 100 gm daily intake with T4 groups.

Weight gain

Table 4: Body weight gain of sheep fed natural grass grazing basal diet supplemented with different concentrate mixture and urea molasses feed block

Body weight	Treatments				Sig
	*T1	T2	T3	T4	
Initial (kg)	21.5± 0.46	22.00 ± 0.46	22.13 ±0.46	22.13 ± 0.46	NS
Final (kg)	23.25 ± 0.86	28.63 ± 0.86	26.5 ± 0.86	24.63 ± 0.86	< 0.001
Total gain(kg)	1.75 ± 0. 66^{b}	6.63 ± 0. 66^{a}	4.38 ± 0. 66^{ab}	2.5 ± 0.66^{b}	< 0.001
Gain/ day (g)	19.25±7.32^{b}	73.75 ± 7.32^{a}	48.75 ± 7.32^{ab}	27.63 ± 7.32^{b}	< 0.001

In this study the body weight gain of the experimental sheep fed with graded level of noug seed cake and wheat bran (T2) and supplemented with grade levels of cotton seed cake and wheat bran mixture (T3) and UMB supplemented group T(4) are presented in Table 3. The final body weight, total body weight and daily body weight gain was significantly different (P<0.05) in (T2) than the UMB (T4), (T3) and to the control treatment (T1).

The average daily weight gain range in concentrate supplemented group T2 and T3 (48.75-73.5 g/day) observed in the present study was higher with the result (25-34 g/day) reported by Abebe (2008). The higher live weight gains of the supplemented groups with concentrate supplementing T2 and T3 may be due to adequate amount of nutrients in concentrate mixture the CP and energy are comparable than natural grass grazing without supplementation in T1. Treatment 4 UMB with lower energy (1.93) but high CP (27.46) affects the synergetic effects of the two nutrient. The supplemented sheep with similar gm /day have got lower weight gain results was observed (27.3 g/day)in this study than 21.6g, 42.4g, 46.1g, and 46,4g respectively to those of Ibrahim (1991).

The concentrate supplemented group average daily body weight gain observed in this study were lower than the gain (60- 95 g/day) reported by Wegene (2008) in Blackhead Somali sheep supplemented with energy and protein source. However, the range of body weight gain as observed in the current finding is higher than the values (32-63 g/day) reported by Hirut (2008) for Hararghe highland sheep supplemented with concentrate mixture and also (70gram/day) reported by Habtemariam,e.t.a.l,,(2011)

There was no weight loss observed as a result of non-supplementation. This may be attributed to the appreciable amount of nutrients in the grazed natural grass during experimental time. The higher live weight gains of the supplemented groups with concentrate supplementing T2 and T3 may be due to adequate amount of nutrients in concentrate mixture than natural grass grazing without supplementation in T1. The intake in (T4) multi nutritional blocks was lower than the two supplemented groups, which the feeding habit of the sheep limits the supplemented feed block intake; it results low nutrient supplement intake and results low weight gain.

c) Partial Budget Analysis

The result of partial budget analysis is indicated in Table 4. In this study the partial budget analysis observed that T2, T3 and T4 has similar marginal return than, but T1 has lower than the other treatments. Marginal return was 1.55, 1.52, 1.40 and 1.44 for T1, T2, T3 and T4, respectively.

Table 5: Partial budget analysis on body weight gain of Abera sheep fed a basal diet of grazing natural grass; supplemented with different types of concentrate mixtures and urea molasses feed block

Parameters	Treatments			
	* T1	T2	T3	T4
Average final weight kg/ head	23.25	28.63	26.5	24.63
Cost of live weight kg/ head (ETB)	40	40	40	40
A. Total gross income(ETB)	930	1145.20	1060	985.20
Cost of sheep/head (ETB)	600	600	600	600
Feed cost				
Total Cost of concentrate (ETB	0	155.25	155.25	38.81
B. Total input cost(ETB	600	755.25	755.25	683.75
Gross profit (A-B)	330	390	304.75	385.20
Marginal revenue (A/B)	1.55	1.52	1.40	1.44

IV. Summary and Conclusion

The study was carried out at Darra district of Abera Gelede village in Abera sheep type improvement substation with the aims of investigating the effects of supplementing concentrate and urea molasses feed block /UMB/ on intake and body weight gain of grazing Abera sheep. All treatment diets had higher CP content than the rumen microbial requirement. The UMB had higher CP and lower NDF, energy and ADF content than the other two experimental supplemented feeds, but the low intake of urea molasses feed block resulted in lesser amount DM, OM, CP, NDF, energy and ADF intake. That attributed to lower weight gain than concentrate supplemented (T2 and T3) groups. The significant difference among treatments was due to the different quantities of nutrient contents of both concentrate diet. Sheep fed on T2 and T3 supplements had higher weight gain than those fed T4 and un supplemented control group T1. T2 has significant difference ($P<0.05$) on weight gain performance than T1 and T4, but comparable weight gain with T3. The net return obtained from all treatments were T2 >T4 >T1 >T3 across the treatments.

V. Recommendations

Three hundred gram concentrate /head /day supplementation (66% noug seed cake mixed with 33% wheat bran and 1% salt) has significant difference on short term weight gain and economically feasible for the areas where community based sheep improvement and small holder farmers. It was also economical at small-scale farmers' level, with average gross profit of 390 ETB in the study area. Besides, famers and extension workers had appreciate fattening practice with concentrated feed supplementation than conventional fattening practice.

VI. Acknowledgment

The authors would like to acknowledge the Southern Region Agricultural Research Institute, Hawassa Agricultural Research Center for budget allocation and facilities during all the research works and review. Darra small ruminant breed improvement research substation all workers, to their endeavor in management of the experimental animals and data collection and Dr Yisehak Kechero, Associate professor College of Agricultural Science -Arba Minch University and Ato Tadesse Bokore from Hawassa University Agricultural Campus Animal Nutrition Laboratory assistance also deserve great appreciations for his help on the experimental sample feed analysis.

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Additional Documents

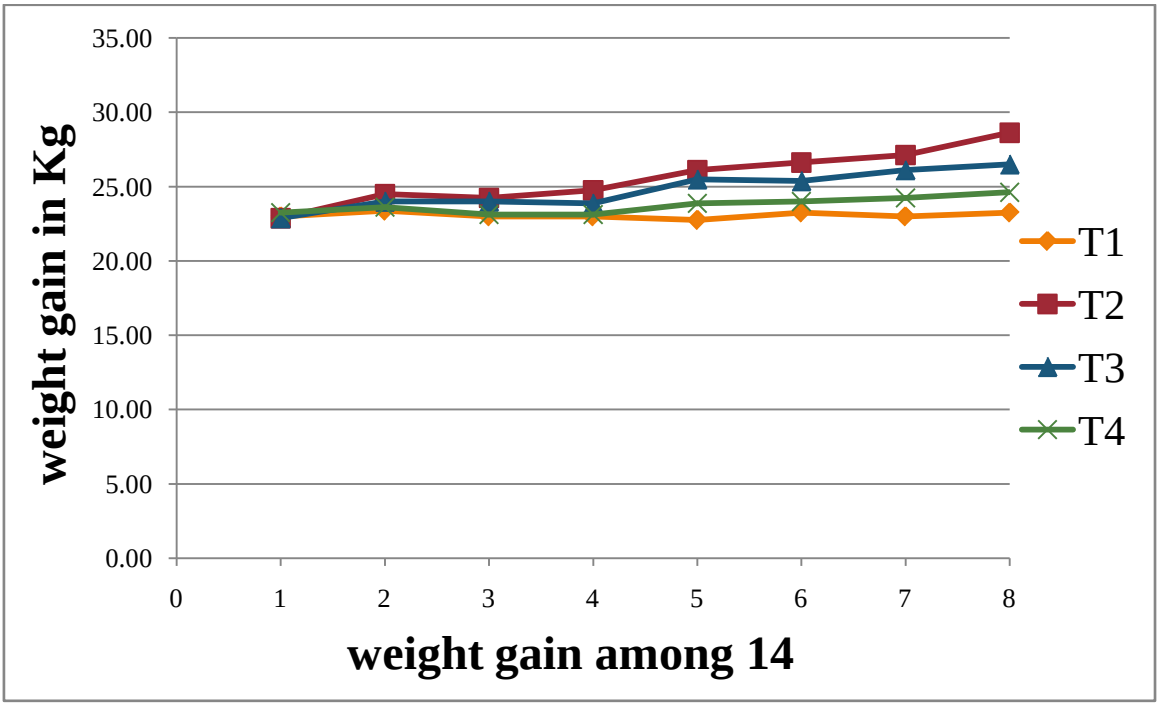

Fig. 1: The body weight gain/change/ trend

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Review on Major Assisted Reproductive Technologies

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Abstract- Since early period, several reproductive technologies practiced as a prime concern for researchers, employed for genetic improvement of farm animals. This review deals with the assisted reproductive technologies (ARTs) among the known approaches for genetic improvements. This review paper focused on artificial insemination (AI), estrus synchronization, multiple ovulation and embryo transfer (MOET), cryopreservation (freezing) of gametes or embryos and in vitro embryo production (IVEP). Briefly to see, AI is the manual placement of semen in the reproductive tract of the female by a method other than natural mating. AI is the most effective method being used for the genetic improvement of animals. Estrous synchronization is another process of targeting female mammals to come to heat within a short time frame (36 to 96 hours) that is to have a number of females in estrus during a very short period.

Keywords: *ART, AI, assisted, technologies, IVEP.*

GJSFR-D Classification: *FOR Code: 070199*

Strictly as per the compliance and regulations of :

Review on Major Assisted Reproductive Technologies

Bizelew Gelayenew [α] & Getahun Asebe [σ]

Abstract- Since early period, several reproductive technologies practiced as a prime concern for researchers, employed for genetic improvement of farm animals. This review deals with the assisted reproductive technologies (ARTs) among the known approaches for genetic improvements. This review paper focused on artificial insemination (AI), estrus synchronization, multiple ovulation and embryo transfer (MOET), cryopreservation (freezing) of gametes or embryos and in vitro embryo production (IVEP). Briefly to see, AI is the manual placement of semen in the reproductive tract of the female by a method other than natural mating. AI is the most effective method being used for the genetic improvement of animals. Estrous synchronization is another process of targeting female mammals to come to heat within a short time frame (36 to 96 hours) that is to have a number of females in estrus during a very short period. Superovulation is also a method when an animal is induced (usually through use of injectable hormones) to ovulate multiple ova (the hormonal treatment for harvesting increased number of oocytes from the ovary than normal). Cryopreservation is another technique operated by storing a low temperature for a long-term storage to preserve the structurally intact living cells and tissues for extended period at a relatively low cost. The other ARTs method is embryo transfer, which is carried out on a variety of agricultural animals, to a greater or lesser extent depending on the species. IVEP includes three major steps: in vitro maturation (IVM), in vitro fertilization (IVF) and in vitro development (IVD) of the resulting embryos. In conclusion, animal biotechnologies related to reproduction have contributed too many improvements in agriculturally important traits in livestock. Reproduction lies at the heart of any livestock breeding enterprise and is vital to maintain or increase the number of animals required for production.

Keywords: ART, AI, assisted, technologies, IVEP.

I. Introduction

Genetic improvement of farm animals is a prime concern over the years for researchers. Several reproductive technologies have been employed to achieve this (Vikrama, 2010). Among them, the application of assisted reproductive technologies (ARTs) plays a great role, which enables the rate of genetic progress to be increased (Nicholas, 1996; Vivanco-Mackie, 2001). Major assisted reproductive technologies, which play paramount importance in livestock utilization, include artificial insemination (AI), estrus synchronization, multiple ovulation and embryo transfer (MOET), cryopreservation (freezing) of gametes or embryos and *in vitro embryo* production (IVEP). To take full advantage of the benefits of assisted reproductive technologies, one must understand the basic physiology of the female and male reproductive systems as well as various methods of reproductive cycles (Paterson *et al*., 2003).Therefore; this review is aimed to achieve the major assisted reproductive technologies (ARTs).

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II. Assisted Reproductive Technologies (ARTs)

a) *Artificial Insemination (AI)*

Artificial insemination (AI) is the manual placement of semen in the reproductive tract of the female by a method other than natural mating. It is one of a group of technologies commonly known as "assisted reproduction technologies" (ART), whereby offspring are generated by facilitating the mating of gametes (spermatozoa and oocytes). AI is the most effective method being used for the genetic improvement of animals. According to Durrant (2009) and Vishwanath (2003), AI is the ART that is less complex, invasive and costly and is therefore the first logical choice for companion animals or non-domestic endangered animal species. In the present scenario a large number of AI are performed globally, more than 100 million cattle, 40 million pigs, 3.3 million sheep and 0.5 million goats are artificially inseminated every year (Boa- Amponsem and Minozzi, 2006).

Moreover, by the 1960s, significant improvements in cryopreservation and storage of semen made AI even more accessible to livestock producers (Vishwanath, 2003). In the modern dairy industry, where a large number of dairy cows are managed intensely, AI is widely used. Semen from bulls is especially amenable to freezing and long-term storage. In contrast, for reasons not yet well understood, semen from other livestock species such as horses, pigs, and poultry are more difficult to freeze and store.

b) *Synchronization of Estrus*

Estrous synchronization is the process of targeting female mammals to come to heat within a short time frame (36 to 96 hours) that is to have a number of females in estrus during a very short period of time. This is achieved through the use of one or more hormones (http://en.wikipedia.org/wiki/Estrous_synchr-

onization). Oestrus is synchronized by using PGF2a, GnRH and controlled Intravaginal Drug (Progesterone) Releasing device (CIDR) (Vikrama and Balaji, 2010). It can be also achieved through the use of prostaglandin F2a and progesterone, repeated progesterone injections for 16-17 days, intravaginal sponge [30-40 mg of fluorogestone acetate (FGA) for 11-18 days or 50-60 mg of medroxy progesterone acetate (MAP) for 15-18 days], or by using subcutaneous ear implants with a dose rate of 2-6 mg of progesterone for 9-17 days (Ishwar and Pandey, 1990; Stenbak *et al*., 2001, 2003). Moreover, it is possible to synchronize estrus through luteolysis. Prostaglandin F2a and its analogues have luteolytic action and two injections administered 11 days apart in cycling females' gives satisfactory results (Trounson, 1976; Ishwar and Memon, 1996). According to Vikrama and Balaji (2010), synchronization of oestrus is one of the ways to regulate the oestrus signs detection. It is a very effective method to increase the proportion of animals that are bred at the beginning of the breeding season.

c) Multiple/Superovulation

Superovulation is when an animal is induced (usually through use of injectable hormones) to ovulate multiple ova (the hormonal treatment for harvesting increased number of oocytes from the ovary than normal). This is usually done on animals with superior g enetics, but any cycling female can be superovulated (ht tps://uk.answers.yahoo.com/question/index?qid=20090 306063423AANtpZw). Principles of inducing superovulat ion in sheep are the same as in cattle. A follicle stimulating gonadotropin is administered either near the end of the luteal phase of the cycle (Days 11-13) or around 1 or 2 days before the end of the synchronizing treatments (Stenbak *et al*., 2001, Grazul-Bilska *et al*., 2003). Multiple ovulations are an effective means of increasing the contribution of superior females to breeding programs and it is also an essential procedure of embryo biotechnology. Despite its application in many domestic species, there are still many problems. For instance, rates of ovulation are still unpredictable. This causes problems not only in animal production but also in the application of embryo biotechnology. It is known that factors such as breeds (Terawaki *et al*., 2002), ovarian status (Gonzalez- Bulnes *et al*., 2000; 2002), gonadotrophin preparation (Lopes da, 2001; Gonzalez-Bulnes, 2000), nutrition (O'Callaghan *et al*., 2000; Armstrong *et al*., 2001), season (Mitchell *et al*., 2002; Chagas *et al*., 2003), photoperiod (Mutiga *et al*., 1984) and repeated superovulation (Cognie, 1999; Magarey *et al.,* 2003) affect superovulation as well as the quality of embryos produced.

d) Cryopreservation

Cryopreservation is a long-term storage technique with very low temperatures to preserve the structurally intact living cells and tissues for extended period of time at a relatively low cost (Tsai and Lin, 2012). It is the freezing of cells or tissues to subzero temperatures, typically -196 ^{o} C. This temperature is the boiling point of liquid nitrogen, a common agent using in the freezing and storage process. At this temperature, all biological activity is stopped or paused until it is thawed. The freezing of sperm needs vitrification agents that minimize damage to the cells during the freezing and thawing process (Wikipedia, 2015). With the development of ARTs the necessity of developing successful cryopreservation methods for reproductive cells and embryos became quickly evident. The freezing of sperm was initiated over 50 years ago. This was the first successful cryopreservation of spermatozoa. Cryopreserved sperm, oocytes and embryos are used for artificial insemination and embryo transfer in the livestock industry. Frozen semen can be used during AI and during *in vitro* embryo production (IVEP) schemes. In the 1950s, with the use of glycerol as cryoprotective, frozen bull semen methods allowed a great increase in the use of AI in the dairy industry (Polge, 1949; Woods, 2004). Bull semen has the best cell recovery percentage after thawing (50-70%) (Hiemstra, 2005; Vishwanath, 2003) compared to other livestock species.

Cryopreserved oocytes and embryos provide the opportunity to overcome the difficulties of donor recipient synchronization during super/multiple ovulation and embryo transfer. Maturation, fertilization and embryo development of cryopreserved oocytes has been achieved in a number of species (Hiemstra, 2005). The feasibility of the technique has been demonstrated by the birth of live animals using cryopreserved oocytes (Maclellan, 2002; Otoi, 1996; Stachecki, 2002). Moreover, cryopreservation of embryos of many mammals has achieved acceptable rates of success. The birth of live offspring from cryopreserved embryos is possible for many species (Hasler, 2001; Squires, 2003). In bovine, cryopreservation of embryos is highly successful with both slow freezing and vitrification protocols (Woods, 2004). However, pregnancy rates with fresh embryos are still significantly higher than after cryopreservation (Hasler, 2001).

e) Embryo Transfer (ET)

Embryo transfer is a multi-step process that involves the production and collection of preimplantation embryos from genetically superior females (called donors) and the subsequent transfer of the harvested embryos into reproductively healthy females (called recipients) for the purpose of establishing pregnancies and producing live offspring that is genetic ally unrelated. Embryo transfer is carried out on a variety of agricultural animals, to a greater or lesser extent depending on the species. It is used extensively in the beef cattle industry (http://hsc.csu.edu.au/agriculture/ electives/ 21st/2409/ embryo_ transfer.htm).

The first successful embryo transfer in mammals was performed with rabbits in 1890 (Heape, 1891), but it was more than 70 years later that the first successful embryo transfer in cattle was reported (Willett et al., 1951). Today, more than ¾ million bovine preimplantation embryos are transferred each year throughout the world (Thibier, 2006). Embryo transfer technology is an important tool to improve livestock at faster rate as well as gives an opportunity to utilize the genetic contribution of both male and female at the same time. With the help of ET (embryo transfer) or MOET (multiple ovulation embryo transfer) techniques faster improve of livestock, rapid expansion of elite animals, genetic gain, accelerated herd development and conservation of rare genetic stocks could be achieved (Nicholas and Smith, 1983).

Surgical embryo transfer is in principle possible in all mammalian livestock species. In contrast, non-surgical embryo transfer is only possible in cattle (routinely performed), horses and also pigs, although still not as efficient as in cattle and horses. For embryo transfer purposes, embryos can either be flushed from donors or can be produced *in vitro*. Depending on the species, embryos can be recovered from donor females of superior genetic merit by surgical or non-surgical techniques. In cattle and horses, efficient techniques recover fertilized embryos without surgery, but only one or sometimes two embryos are produced during each normal reproductive cycle. The recovered embryos are then transferred to recipient females of lesser genetic merit. They are transferred to the uterus or oviduct of recipients by laparotomy or using a laparoscopic technique. Comparison of the laparoscopic and surgical transfer of embryos showed that the laparoscopic method can achieve high pregnancy rates (Stefani *et al*., 1990). It appears, that laparoscopic transfer is a safe, minimally invasive surgical procedure and it should be recommended for transfer of embryos in small ruminants.

f) In vitro Embryo Production (IVEP)

IVEP includes three major steps: *in vitro* maturation (IVM), *in vitro* fertilization (IVF) and *in vitro* development (IVD) of the resulting embryos. However, primary oocytes collection should be added upstream of these major steps and embryo management (freezing, transfer) should be added downstream to give a complete overview of the whole process. Once the immature oocytes have been removed from the ovary, they are matured, fertilized, and cultured *in vitro* for up to seven days until they develop to a stage that is suitable for transfer or freezing (http://www.nifa.usda.gov/nea/animals/infocus/reproduction_if_assisted.html). Since the birth of the first IVEP calf in 1982, thanks to intensive research programs worldwide, cattle IVEP has done significant progress (Mermillod *et al*., 2006).

Although each ovary contains hundreds of thousands of oocytes (eggs) at birth, many thousands undergo atresia and are lost, starting before birth. This tremendous loss of genetic material could be salvaged by harvesting oocytes from the ovary and using IVEP techniques (Hasler *et al*., 1995). Bovine IVEP is now a reasonably efficient procedure; trans vaginal ultrasound-guided oocyte aspiration at frequent intervals, in combination with in-vitro fertilization (IVF) has proved its worth in improving the yield of embryos from designated donors, salvaging irreplaceable genetics following slaughter in the face of infectious disease control or in culling for other reasons (Hasler, 2003).

III. Conclusion

Animal biotechnologies related to reproduction have contributed too many improvements in agriculturally important traits in livestock. Reproduction lies at the heart of any livestock breeding enterprise and is vital to maintain or increase the number of animals required for production. Among the reproductive technologies, animal breeders have made widespread use of ARTs to accelerate genetic improvement programs aimed at obtaining more, better and cheaper food products. ARTs like AI, estrus synchronization, MOET cryopreservation (freezing) of gametes or embryos and IVEP have contributed to animal breeding programs faster transmission of desirable traits/genetic improvement by increasing offspring of selected males and females and the reduction of the generation interval in livestock populations in a shorter period of time compared to classical approaches as well as they provide a number of advantages. Therefore, ARTs require technical improvements and refinements but this will not be sufficient to provide benefits if the public opinion is not correctly informed and made aware of the advantages and the risks associated with the progress of science.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 8 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Determination of the Impact of Raindrops on Soils in Auchi Polytechnic using Morgan's Splash Cup

By Eriakha E. C., Ajayi A. S. & Duweni E. C.
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Abstract- Erosion by water, at a global scale, is the main soil degradation process in agricultural areas. Raindrops are among the major soil-detaching agents, and the kinetic energy of falling rain has an important influence on erosion intensity. The aim of this study was to fabricate a Morgan Splash cup and to determine the kinetic energy and amount of soil splashed by raindrops using the splash cup. Three locations were chosen for this study (Agricultural Engineering Demonstration farm (A), e – learning centre (B) and campus two(C)). The result of this study showed that soil splashed was higher in campus 2 with a value of 7 g/m^2. The mean soil splashed for the three locations are 1.78, 0.53 and 2.20 g/m^2 for field A, B and C respectively. The soil splashed is observed to increase with increased Kinetic Energy of rainfall. Thus, the greater the rainfall and Kinetic Energy, the greater the soil splashed. It is therefore recommended that studies of splash erosion on cultivated land should be carried out to determine the effect of cultivation on the soil in the area.

GJSFR-D Classification: *FOR Code: 969999p*

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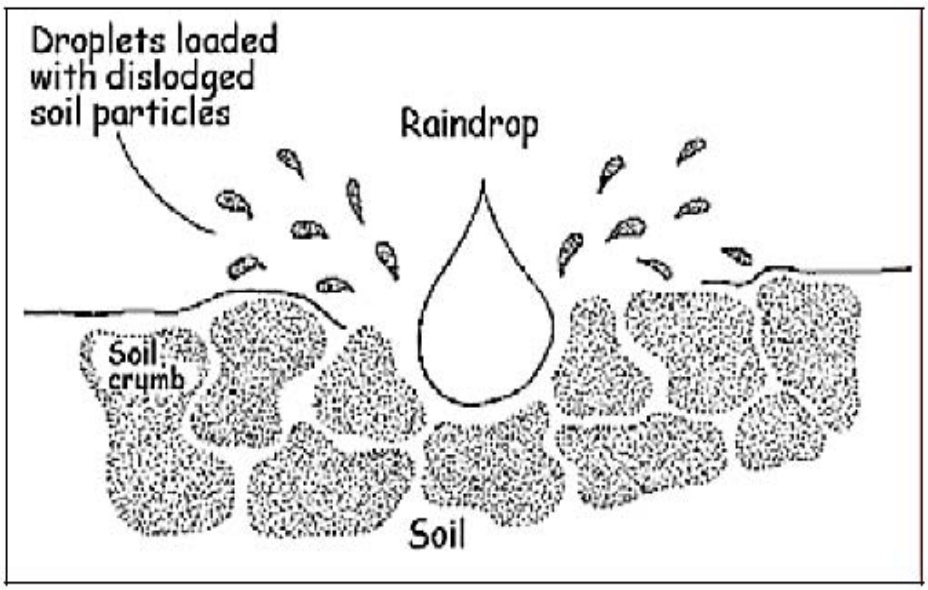
Eriakha E. C. [α], Ajayi A. S. [σ] & Duweni E. C. [ρ]

Abstract- Erosion by water, at a global scale, is the main soil degradation process in agricultural areas. Raindrops are among the major soil-detaching agents, and the kinetic energy of falling rain has an important influence on erosion intensity. The aim of this study was to fabricate a Morgan Splash cup and to determine the kinetic energy and amount of soil splashed by raindrops using the splash cup. Three locations were chosen for this study (Agricultural Engineering Demonstration farm (A), e – learning centre (B) and campus two(C)). The result of this study showed that soil splashed was higher in campus 2 with a value of 7 g/m^2. The mean soil splashed for the three locations are 1.78, 0.53 and 2.20 g/m^2 for field A, B and C respectively. The soil splashed is observed to increase with increased Kinetic Energy of rainfall. Thus, the greater the rainfall and Kinetic Energy, the greater the soil splashed. It is therefore recommended that studies of splash erosion on cultivated land should be carried out to determine the effect of cultivation on the soil in the area.

I. Introduction

Soil erosion is recognized as one of the world's most serious environmental problems. Globally, about 80% of the current degradation of agricultural land is caused by soil erosion (Zegeye, 2009). Erosion by water, at a global scale, is the main soil degradation process in agricultural areas. It generates strong environmental impacts and major economic losses from decreased agricultural production to off-site effects on infrastructure and water quality by sedimentation processes (Zegeye, 2009).

Raindrops are among the major soil-detaching agents, and the kinetic energy of falling rain has an important influence on erosion intensity (Morgan 1981). The process of soil detachment by raindrops is often referred to as splash erosion or rain splash. Splash erosion (as shown in figure 1.1) therefore, is a process composed by detachment of soil particles by raindrops hitting the surface followed by splash transport of (a part of) the detached particles.



Source: (Kinnell, 2005)

Figure 1.1: Raindrop impact causing Soil Splash

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Various methods have been used to measure splash erosion both experimentally and on the field. This depends on the objective of the experiment if it is solely to determine splash detachment or to obtain sufficient information to model the splash process. In which case, data are required on the direction, height and distance of movement of the splashed particles. Splash erosion has been measured in the field by splash boards; small funnels or bottles inserted in the soil; monitoring painted stones; and radioactive tracers to mention but a few (Egharevba and Ibrahim 2005).

Most investigations carried out on splash erosion have largely been done in the laboratory. There is need for field studies of splash erosion in specific locations in order to be able to ascertain the extent of damages caused. The aim of this paper therefore is the field study of splash erosion from bare soil using Morgan's splash cups. The understanding of the impact of splash erosion and data obtained from field studies can greatly assist soil conservationists and soil and water engineers in the design of erosion control structures.

II. Materials and Methods

a) Study Area

This study was carried out in three locations namely: Agricultural Engineering experimental field (Field A), the field beside E – learning center (Field B) and campus 2 Auchi Polytechnic Auchi (Field C). Auchi Polytechnic shown in figure 3.1 is located between latitude 7^0 10' and 7^0 20' north of the equator and longitude 6^0 16' and 6^0 36' east of the Greenwich Meridian with an altitude of 207m.

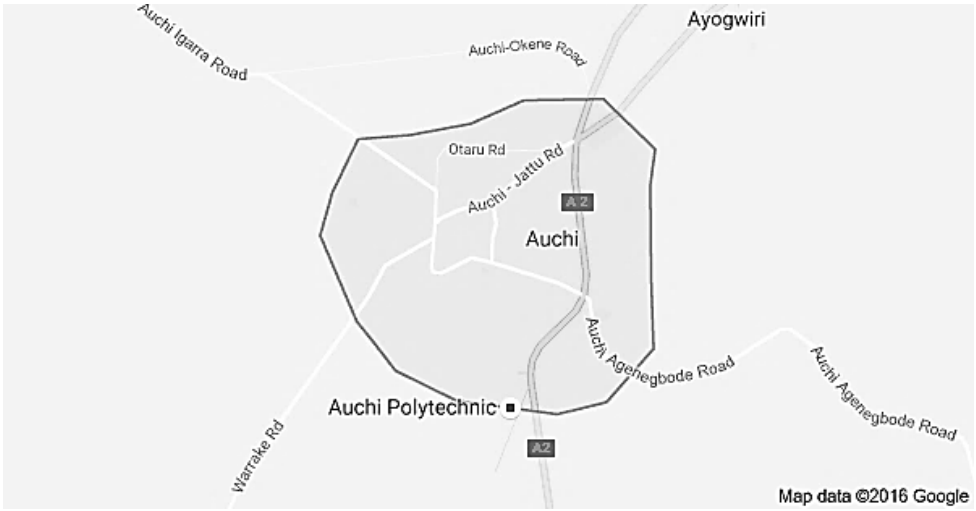

Figure 3.1: Google map of Auchi Polytechnic and its environs

b) Soil Characteristics

The soil characteristics of the study area were obtained from previous studies in the department of Agricultural and Bioenvironmental Engineering, Auchi Polytechnic Auchi, Edo state. The average textural class of the study area is Sandy Loam and Loam soil with an average bulk density of 1.47 g/cm^3.

Table 3.1: Average soil physical characteristics of Field A, B and C

Location	Depth (cm)	%Sand	%Silt	%Clay	Textural Class	θ_i	θ_f	BD (g/cm^3)
A	0-15	60	22	18	Sandy Loam	12.6	44.1	1.48
	15-30	58	23	19	Sandy Loam	13.2	44.2	1.48
B	0-15	57	29	14	Sandy Loam	15.8	44.8	1.46
	15-30	61	20	19	Sandy Loam	13.2	43.9	1.49
C	0-15	45	34	21	Loam	14.3	45.4	1.45
	15-30	46	32	22	Loam	14.8	45.2	1.45

Source: Victory et al., (2015)

c) Description of the Field Experiment

The field study was carried out on three sites. Six Morgan's splash cups was constructed and installed on the selected sites, to determine the soil splash under the same rainfall intensity and kinetic energy. Rainfall data was obtained from the Department of Civil Engineering in order to obtain the rainfall amount and duration per field experiment. The splash cups fabricated were covered with fine linen (muslin cloth) laid at the outside diameter of the cup, to prevent passage

of splashed soil through the drain while also avoiding the ponding of the inner cylinder and also to avoid sediment loss. This allows the water to slowly drain from the cups but prevent the sediment from escaping. And, a thread material was used to tie the linen cloth to the outer diameter to prevent it from being removed during rainstorm impact. Also, hammer was used to drive the inner cylinder into the soil without disturbing the soil surface, so that cylinder rim levels with the soil surfaces. This helps to reduce 'rim effect' (Morgan, 2005).

d) Splash Monitoring and Computation of Kinetic Energy of Rainfall

The soil splashed was carefully collected from the muslin cloth and oven dried at 105°C for 24 hours and weighed after every rainfall event. The kinetic energy of the rainfall was computed using the empirical expression by Kowal and Hassan (1976) given as:

$$KE = 41.4\, R_a - 120.0 \qquad \text{Eq. (1)}$$

Where R_a = Rainfall amount (mm), and KE= energy of rainfall (J/m^2)

R_a = rainfall amount (mm), and K.E = Kinetic energy of rainfall (J/m^2).

III. Results and Discussion

a) Rainstorm depth and Kinetic Energy

Table 4.1 shows the rainfall depth (amount) and the corresponding Kinetic Energy (KE) of the rainstorm in the season. The rainstorm depth ranged from 5 to 81 mm and the computed KE obtained ranged from 87 to 3233.4 J/m^2. A total of 23 rainfall events were recorded in the season under study. The highest rainstorm recorded occurred in the month of August with its amount recorded as 81mm and 3233.4J/m^2 Kinetic energy. The month of September had the highest number of rainfall occurrence.

Table 4.1: Rainfall depth and Kinetic Energy of raindrops

S/No.	Date	Rainfall Amount (mm)	Kinetic Energy (J/m^2)
1	7/8/2016	50.00	1950.00
2	11/8/2016	55.00	2157.00
3	15/08/16	72.00	2860.80
4	16/08/16	9.00	252.60
5	3/9/2016	81.00	3233.40
6	4/9/2016	7.00	169.80
7	6/9/2016	5.00	87.00
8	9/9/2016	11.00	335.40
9	10/9/2016	12.00	376.80
10	13/09/16	69.00	2736.60
11	14/09/16	13.00	418.20
12	20/09/16	11.00	335.40
13	22/09/16	45.00	1743.00
14	23/09/16	67.00	2653.80
15	26/09/16	6.00	128.40
16	29/09/16	60.00	2364.00
17	30/09/16	10.00	294.00
18	2/10/2016	36.00	1370.40
19	4/10/2016	7.00	169.80
20	5/10/2016	10.00	294.00
21	6/10/2016	12.00	376.80
22	8/10/2016	9.00	252.60
23	10/10/2016	45.00	1743.00
Total		702.00	26302.80
Mean		30.52	1143.60

b) Soil splashed for the three fields under Study

Table 4.2 shows the soil splashed (g/m^2) from the three fields under study and for the rainfall event recorded under the Morgan cup.

Table 4.2: Soil splashed (g/m^2) for the three fields under study

S/N	Date	Soil splashed (g/m^2)		
		Field A	Field B	Field C
1	7/8/2016	4.69	1.25	6.37
2	11/8/2016	2.27	0.79	2.19
3	15/08/16	1.17	0.53	1.65
4	16/08/16	0.40	0.10	0.49
5	3/9/2016	0.37	0.09	0.44
6	4/9/2016	4.06	1.54	6.11
7	6/9/2016	0.39	0.05	0.45
8	9/9/2016	4.77	1.99	6.50
9	10/9/2016	0.05	0.03	0.39
10	13/09/16	0.38	0.11	0.54
11	14/09/16	0.37	0.13	0.55
12	20/09/16	1.50	0.15	0.56
13	22/09/16	0.43	0.04	0.59
14	23/09/16	1.10	0.08	0.57
15	26/09/16	4.84	1.57	7.00
16	29/09/16	0.41	0.11	0.51
17	30/09/16	2.30	0.12	0.56
18	2/10/2016	3.79	1.44	6.38
19	4/10/2016	2.20	0.06	0.50
20	5/10/2016	4.43	1.52	6.53
21	6/10/2016	0.37	0.15	0.57
22	8/10/2016	0.45	0.19	0.67
23	10/10/2016	0.12	0.22	0.49

Table 2 also shows that the soil splashed for field C which is the field located at campus 2 are generally higher having the highest value of 7 g/m^2. The soil splashed from the demonstration farm behind the Agricultural Engineering workshop ranged from 0.05 – 4.84 g/m^2, while that of e-learning centre ranged from 0.39 – 1.99 g/m^2, the values of soil splashed around e – learning centre are quite low due to student's activities around the environment which must have compacted the soil thereby making it difficult for the raindrop to erode, erosion in this area will be very minimal since soil movement and detachment is minimal.

IV. Conclusions

The following conclusions are drawn from this study:

1. The observed soil splashed was higher in campus two with a maximum value of 7 g/m^2.
2. The mean soil splashed for the three locations are 1.78, 0.53 and 2.20 g/m2 for Agricultural and Bio-Environmental Engineering demonstration farm, e – learning center and campus two (2) respectively.
3. The soil splashed is observed to increase with increased Kinetic Energy of rainfall. Thus, the greater rainfall and Kinetic Energy, the greater the soil splashed.

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The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

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The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

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The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

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After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
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Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
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"

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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

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30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

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- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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ISSN 9755896