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# Farmers' Production Constraints, Knowledge of *Striga* and Preferred Traits of Pearl Millet in Jigawa State, Nigeria

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## I. Introduction

Pearl millet provides food for over 40 million people in northern Nigeria. It is very important to the nation's agricultural sector because of its high degree of adaptation to stress environments such as severe drought, poor soils and high temperature making it a great relief to life in the Sahel (Rai & Kumar, 1994).

The grain is used primarily for human consumption because of its high level of fat and protein (the protein content varies between 10.9 to 16.9%) (Okoh et al., 1985) and its digestibility is better than that of sorghum (Rooney & McDonough, 1987). In Nigeria from 1992 to 1994, 3.3 million tons of millet was used directly as food, 1.2 million tons for seed, beer, and only 0.1 million tons were used as livestock feed (Obilana, 2003).

According to DIIVA Project report 2010, some improved cultivars were released in Nigeria but adoption by the small-scale farmers are low, with only 24% using improved varieties and 75% local varieties. Kidoido et al. (2002) suggests a number of reasons for low adoption of improved varieties and principal among them is the failure of breeders to involve and incorporate farmers' concerns in their cultivars development.

Participatory rural appraisals have been used in developing countries to make use of rural community's knowledge in agricultural research. A participatory rural appraisal enables local communities to analyze their own conditions, plan and make decisions (Chambers, 1994). Interestingly, farmers are increasingly participating in agricultural research as scientists and development workers become more aware of the philosophy of 'farmer first' and its effectiveness. Before engaging any successful and sustainable breeding programme, it is necessary to document the end-users' perceptions regarding preferences and constraints affecting the crop. However, little is known about farmers' production constraints, their preferred pearl millet varietal traits and perception of *S. hermonthica*, although a number of studies have attempted to include farmers in participatory approaches to breeding of pearl millet in Nigeria. A survey conducted by Dugje et al. (2006) in Yobe state Nigeria, indicated that farmers rated *Striga* infestation as the most important production constraint coupled with low soil fertility. The use of pearl millet varieties that are able to resist these conditions would increase yield in farmers' field and subsequently improve livelihood in Jigawa state. Emechebe et al. (2004) conducted PRA to identify farmers' perception of *Striga* problem and its control in Nigeria. Also, Coulibaly et al. (2017) conducted a PRA study to identify groundnut production constraints in Niger.

Adoption rates of improved technologies in developing countries is low, therefore, it is essential to identify and incorporate farmers' varietal preferences in breeding programmes and document and recommend solutions to production constraints in order to increase the acceptability of new and improved varieties.

Therefore the objectives of this research were to:

i) Assess farmers' pearl millet preferred traits
ii) determine farmers' production constraints in pearl millet, and
iii) Assess farmers' knowledge on *Striga hermonthica* in pearl millet

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## II. Methodology

*a) Study area*

This study was conducted in six villages comprising two each from three local government areas (LGA) of Jigawa State in Nigeria. The villages were Madobi and Kudai from Dutse LGA (11°46'39''N and 9°20'03''E), Karfawa and Shuwarin in Kiyawa LGA (11°47'05''N and 9°36'30''E) and Kafingana and Kantoga in Birninkudu LGA (12°59'53''N and 8°54'35''E). Dutse and Birninkudu are located in the southern region while Kiyawa is located in the south eastern region of Jigawa state. The regions are characterized by monomodal average annual rainfall of 743, 734 and 820mm for Dutse, Kiyawa and Birninkudu respectively.

*b) Selection of Study Sites and Sampling Method*

A preparatory survey was conducted in Jigawa state to identify and select the villages were pearl millet is largely cultivated, farmer groups and individual farmers. A multi-stage sampling procedure was used to select the sites for the study that represented diverse ecological and socio-economic environments in the pearl millet growing areas of Jigawa State. The first stage included purposive selection of three LGA from the state based on the potentials for pearl millet production. The second stage involved random selection of two villages from each of the LGAs. The last stage involved random sampling of 23 to 24 pearl millet farmers from each of the selected villages, to give a total of 143 farmers which constituted the sample size for the study (Table 1). A survey was further conducted with individual farmers.

*Table 1:* PRA sites and number of farmers interviewed

| Villages | Local governments | No. of farmers (survey) | No. of farmers (FGD) | |
|---|---|---|---|---|
| | | | Males | Females |
| Madobi | Dutse | 15 | 4 | 5 |
| Kudai | Dutse | 15 | 6 | 3 |
| Karfawa | Kiyawa | 15 | 5 | 4 |
| Shuwarin | Kiyawa | 15 | 6 | 3 |
| Kafingana | Birninkudu | 15 | 6 | 2 |
| Kantoga | Birninkudu | 15 | 4 | 5 |

*c) Data Collection and Analysis*

The PRA techniques used were focus group discussion (FGD), matrix ranking and individual interviews. At each site of the PRA, the local extension officer led contact with the groups, introduced groups and facilitated the discussion in the local dialect. The study was divided into two components: i) focus group discussions were conducted to reveal the preferred varietal traits, production constraints and knowledge on *S. hermonthica*, and ii) a survey was also conducted with individual farmers to confirm the PRA findings.

The discussions were to determine the pearl millet trait preferences, main constraints to pearl millet production, assess their knowledge on *Striga* and their coping mechanism. Farmers were seated in a semi-circle to facilitate identification of key points raised by each farmer and also ensure full participation by all the participants. The FGDs was conducted using a checklist and the trait preferences and production constraints were subsequently ranked using the pair-wise ranking method. A semi-structured questionnaire was used for the survey to supplement the findings from the FGDs. The survey focused particularly on pearl millet farmers who grew the crop every year. Participants were encouraged to express their views and disagree with one another on issues if there is need. The order in which topics were covered was flexible but generally the sessions started with more general issues and slowly moved into more specific ones. Towards the end, a few probing questions were asked to get in-depth information or to clarify earlier responses. Data generated were coded and analysed using SPSS computer package (version 20).

## III. Results

*a) Farmers' Preferred Traits in Pearl millet*

*Striga* resistant in pearl millet was ranked the most important trait to be improved across all the districts (ranked 1) except at Kafingana where it was ranked 4th most preferred, followed by tolerance to shattering as the second most important trait to be improved in Kudai, Kafingana and Shuwarin (Table 2). Downy mildew resistance is the most important trait to be improved in Kafingana (ranked 1). Although early maturity is an important trait for improvement in most crops, all farmers reported that they preferred late maturing varieties (early/medium maturity ranked from 10-13 across villages). High grain yield had a low ranking (8 to 10) across villages.

*Table 2:* Farmers' preferred traits ranked according to importance

| Variety characteristics | Dutse | | Birninkudu | | Kiyawa | |
|---|---|---|---|---|---|---|
| | Madobi | Kudai | Kafingana | Kantoga | Karfawa | Shuwarin |
| Maturity (Early/medium) | 11 | 11 | 11 | 13 | 13 | 10 |
| Yield (high) | 10 | 8 | 8 | 8 | 10 | 8 |
| Plant height (medium) | 12 | 10 | 11 | 11 | 14 | 13 |
| Panicle length (medium) | 13 | 12 | 10 | 12 | 12 | 12 |
| Panicle size | 11 | 8 | 9 | 10 | 11 | 10 |
| Grain size (bold) | 8 | 9 | 9 | 9 | 9 | 8 |
| Grain color (grey) | 8 | 7 | 7 | 7 | 7 | 7 |
| Thresh ability | 9 | 10 | 7 | 9 | 9 | 11 |
| Grain hardness | 7 | 6 | 6 | 5 | 7 | 7 |
| Taste | 6 | 7 | 5 | 5 | 7 | 4 |
| Storability | 6 | 5 | 5 | 4 | 8 | 5 |
| Panicle compactness | 5 | 6 | 6 | 6 | 7 | 6 |
| Panicle bristle | 14 | 13 | 11 | 14 | 6 | * |
| Downy mildew Resistance | 5 | 4 | 1 | 3 | 5 | 2 |
| *Striga* Resistance | 1 | 1 | 4 | 1 | 1 | 1 |
| Tolerance to lodging | 3 | 3 | 3 | 2 | 2 | 3 |
| Tolerance to shattering | 4 | 2 | 2 | 3 | 4 | 2 |
| Tillering ability | 2 | 3 | 11 | 2 | 4 | 8 |
| Quality local beverage | 4 | 6 | 2 | 5 | 3 | 4 |

**denotes characteristic not reported*

*b) Constraints to Pearl millet Production*

Table 3 shows the constraints to pearl millet production in Jigawa state. Land shortage was the most important constraint to farmers in Madobi (ranked 1) and Kafingana (ranked 1)(Table 3). Theft, lack of improved seeds, and lack of access to extension agents were the most important constraints to farmers in Kantoga (ranked 1), Kudai (ranked 1) and Karfawa (ranked 1) respectively. Also lack of capital was the most important production constraints to famers in Kudai and Shuwarin (both ranked 1). The major constraint reported across the three local governments was low soil fertility (ranked 2 across villages). Other constraints that occurred across all the villages were: *Striga* infestation and downy mildew disease, such that the farmers were helpless thinking there is no solution to the problems. The other constraints were site specific such as high labour cost and high rainfall.

*Table 3:* Identification of pearl millet production constraints

| | Dutse | | Birninkudu | | Kiyawa | |
|---|---|---|---|---|---|---|
| | Madobi | Kudai | Kafingana | Kantoga | Karfawa | Shuwarin |
| Low soil fertility | 2 | 2 | 2 | 2 | 3 | 3 |
| *Striga* | 3 | 3 | 5 | 3 | 4 | 2 |
| Downy mildew | 5 | 5 | 4 | 5 | 6 | 7 |
| High labor cost | 5 | 4 | 5 | 6 | 7 | - |
| Land shortage | 1 | - | 1 | 7 | - | 5 |
| Theft | 6 | - | 6 | 1 | - | 8 |
| Lack of improved seeds | - | 1 | 2 | 2 | - | - |
| Lack of capital | - | 1 | - | - | 2 | 1 |
| Lack of access to extension agents | - | 5 | - | 4 | 1 | 4 |
| High rainfall | - | - | 2 | 5 | 8 | 6 |

*- denotes constraint not reported*

*c) Farmers' knowledge about Striga in Pearl millet*

Seventy-nine percent of the respondents reported that *Striga* has been a menace in their fields for more than 20 years and that all the cereals they grow were attacked in varying degrees by *S. hermonthica* (Table 4). Most of the farmers reported that, *Striga* damage is more severe when 'maiwa type' millet is heading (42%) or at flowering stage (39%) as the most severe. Farmers also revealed that they grow two types of maiwa millet; long panicle type taking more days (late maturing) to mature and short panicle type taking fewer days to mature (relatively early maturing).

The majority of the farmers (77%) reported that the short panicle type is more resistant to *Striga* infestation than the long panicle type while 12% of the respondents revealed that both the two types of maiwa millet are resistant/tolerant to *Striga*. Most of the farmers hand-pull *Striga* (79%) as their control strategy with few of them using weeding and urea fertilizer application (7%) or addition of urea fertilizer only (4%) to suppress *Striga*. A greater percentage of the farmers use their own saved seeds (80%) without any form of seed treatment (79%). All the respondents (100%) wanted to have 'maiwa type' millet cultivar that is resistant to *S. hermonthica.*

*Table 4:* Assessing farmers' knowledge of *S. hermonthica* and control strategy

| Questions | Response | Percentage |
|---|---|---|
| For how long is *Striga* a problem in your field? | - Less than 20yrs | 21 |
| | - More than 20yrs | 79 |
| At what growth stage is *Striga* a problem? | - Seedling | 18 |
| | - Heading | 42 |
| | - Flowering | 39 |
| | - Maturity | 1 |
| Among the varieties you grow which is most resistant/ tolerant? | - Long panicle | 2 |
| | - Short panicle | 77 |
| | - Both | 12 |
| | - None is resistant | 9 |
| How do you control *Striga*? | -Handpulling/hoe weeding | 79 |
| | - Use of urea | 4 |
| | - Weeding and urea app. | 7 |
| What is your source of seed? | - Other farmers | 9 |
| | - Own saved seed | 80 |
| | - Market | 4 |
| | - Agro dealers | 7 |
| Do you treat your seed before sowing? | - Yes | 21 |
| | - No | 79 |
| Would you like to have *Striga* resistance cultivar? | - Yes | 100 |
| | - No | 0 |

## IV. Discussion

*a) Farmers' trait Preferences in Pearl Millet*

Most farmers rated *Striga* resistance as the most important trait of preference. This is in line with Dugje et al. (2006) in which farmers in Yobe State rated *Striga* as most important constraint and were willing to have resistant cultivars. Farmers in the study area reported that they preferred medium to late maturing cultivars as they are associated with delayed flowering while it is still raining to avoid washing off of pollen that result in poor seed setting and ergot disease thereby minimizing crop loss through disease escape especially if sowing was done at the right time (Thakur et al., 2011; Miedaner & Geiger, 2015; Lubadde et al., 2016). Another factor for the preference of long duration cultivars was because of lack of short duration cultivars available in the study area that is resistant to ergot disease.

As for plant height, farmers preferred medium plant (1 ± 0.2 m) heights because of ease of harvesting as also observed by Owere et al. (2014) in finger millet, and reduced lodging which occurs in taller plants.

Grey grain colour and bold seeds are obvious market parameters that producers concentrate on in order to get better market acceptance, and makes good local beverage and good taste. This is in line with Achot et al. (2014) in sorghum and pearl millet. This probably indicates that the main use of pearl millet in the study areas is for food. All the farmers however, concurred that there was need for improvement in the current cultivars.

*b) Pearl Millet Production Constraints in Selected Districts of Jigawa State Nigeria*

In all the villages, farmers identified low soil fertility as the leading constraint to pearl millet production. Their soil is so poor that most crops do not give appreciable yield without heavy fertilization. This is

one of the reasons why most of them adopt *maiwa* millet cultivation since it grows relatively well even is in poor soils. This finding is consistent with earlier studies carried out by Ibrahim et al. (2015) in pearl millet production.

The major biotic stresses reported across all the districts were *Striga hermonthica* infestation and downy mildew disease, such that farmers were helpless thinking there is no solution to the problems. This study revealed the persistence of *Striga* infestation in pearl millet production which has shown an increasing trend both in terms of incidence and severity over the years as evidenced by farmers' responses and susceptibility of cultivars which were otherwise initially resistant. In Shuwarin, Madobi, Kudai and Kantoga, the prevalence was reported to be exceptionally higher compared to that observed in Karfawa and Kafingana. The increase in prevalence over the years could be due to emergence of new biotypes, recycling of infested seeds and volunteer crops. The other constraints depended on the farmers from the different villages. This finding is line with Lubadde et al. (2016) in which farmers from different sites sometimes have different production constraints.

*c) Farmers' Knowledge of Striga hermonthica*

Each ethnic group designated *Striga* with a precise name. The names are associated with the effect it has on crops ranging from witchcraft, fire and killer. This showed that farmers had awareness of this pest. They went further to highlight the symptoms of infested millet plants and linked *Striga* infestation to low soil fertility. Farmers revealed two varieties of *maiwa* millet and that the two varieties together with the other cereals were attacked in varying degrees by *Striga hermonthica.* On the occurrence of *Striga* infestation, farmers in all locations reported that symptoms were on the increase over the years as also observed by Emechebe et al. (2004) and pointed out the most susceptible and tolerant cultivars. Most farmers reported that *Striga* attack is more severe when millet is either heading or flowering. Farmers agreed that the short panicle *maiwa* millet is more tolerant than the longer one. They also reported that, some of the short panicle varieties which were very tolerant were now showing more symptoms of *Striga* damage than in earlier years.

Farmers in the six villages attributed *Striga* damage to two stages of *Striga* development, as also pointed out by Emechebe et al. (2004) namely underground *Striga* and aboveground *Striga*. They emphatically stated that underground *Striga* does more damage to crops than aboveground *Striga*. However, farmers in the six villages had different views about the factors that were responsible for the increasing incidence and severity of *Striga* damage. For example, farmers in Madobi strongly believed that lack of capital was the primary factor that aggravated *Striga* damage as also observed by Atera et al. (2012) in maize. According to them, lack of capital directly or indirectly results in continuous cereal cropping (due to limited land availability), lack of fertilizer and poor soil fertility. On the other hand, Kafingana farmers considered poor soil fertility (due to continuous cropping and soil erosion) and *Striga* dissemination, on hooves and dung of migrating cattle, as the principal factors that exacerbate the *Striga* problem.

## V. Conclusion

The most preferred traits by farmers were resistance to *Striga*, tolerance to shattering and good quality local beverage. Low soil fertility was the major constraint to pearl millet production followed by the *Striga* as the leading biotic constraint. Farmers had awareness on *Striga* menace and would consider testing new *Striga* control options that will enhance soil fertility and prevent dissemination of *Striga* seeds. This calls for more research and adequate extension services to manage this parasite in order to meet farmers demand and improve food security.

## VI. Acknowledgement

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