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*Menace of Weeds in Crop Production-* Weeds are different from the other pests that pose problems in crop production because the presence of weeds is relatively constant, while outbreaks of insects and disease pathogens are sporadic (Gianessi and Sankula, 2003). 1,800 weeds species cause serious economic losses in crop production, and about 300 species plague cultivated crops throughout the world (Ware and Whitacre, 2004). Weeds are the scarce and silent robbers of plant nutrients, soil moisture, solar energy and also occupy the space which would otherwise be available to the main crop; harbour insect-pests and disease causing organisms; exert adverse allelopathic effects; reduce quality of farm produce and increase cost of production.

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ROLEOFHYDROGENCYANIDESECONDARYMETABOLITEOFPLANTGROWTHPROMOTINGRHIZOBACTERIAASBIOPESTICIDESOFWEEDS

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# Role of Hydrogen Cyanide Secondary Metabolite of Plant Growth Promoting Rhizobacteria as Biopesticides of Weeds

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## I. Menace of Weeds in Crop Production

Weeds are different from the other pests that pose problems in crop production because the presence of weeds is relatively constant, while outbreaks of insects and disease pathogens are sporadic (Gianessi and Sankula, 2003). 1,800 weeds species cause serious economic losses in crop production, and about 300 species plague cultivated crops throughout the world (Ware and Whitacre, 2004). Weeds are the scarce and silent robbers of plant nutrients, soil moisture, solar energy and also occupy the space which would otherwise be available to the main crop; harbour insect-pests and disease causing organisms; exert adverse allelopathic effects; reduce quality of farm produce and increase cost of production.

Yield losses due to weeds in some important crops

| Crop | Yield loss range (%) | Crop | Yield loss range (%) |
|---|---|---|---|
| Rice | 9.1 – 51.4 | Sugarcane | 14.1 – 71.7 |
| Wheat | 6.3 – 34.8 | Linseed | 30.9 – 39.1 |
| Maize | 29.5 – 74.0 | Cotton | 20.7 – 61.0 |
| Millets | 6.2 – 81.9 | Carrot | 70.2 – 78.0 |
| Groundnut | 29.7 – 32.9 | Peas | 25.3 – 35.5 |

Among the pests weeds account for 45 % reduction in yield while the insects 30%, diseases 20% and other pests 5% (Rao, 2000). There are several methods for controlling weeds such as cultural method achieved less efficient, manual weeding is very expensive and it may be difficult to find labour. Additionally, it is strenuous and physically demanding and can cause overload injuries (Hansson et al., 1992; Chatizwa, 1997) and mechanical method such heat treatment consumed more energy which leads to input-cost. Soil solarization is a hydrothermal process, which brings about thermal and other physical, chemical and biological changes in the moist soil during and even after mulching (Stapleton and DeVay, 1986). Dilday et al. (1998) has been reported weed emergence by used of allelopathy approach. Modern weed control, chemical method herbicides are gaining popularity among the farmers. The use of agrochemicals is negatively perceived by consumers and supermarket chains. Use of heavy doses of herbicides creates the problem of resistance development in weed. Another problem is continuous use of one herbicide can change the weed community. The use of microbes to control weeds menace, which is a form of biological

weeds menace, which is a form of biological control, is an environment-friendly approach as sustainable tools. The microbe is a natural enemy of the pathogen, and if it produces secondary metabolites, it does so only locally, on or near the plant surface, i.e., the site where it should act to target. In contrast, the majority of molecules of agrochemicals do not reach the plant at all. Moreover, the molecules of biological origin are biodegradable compared with many agrochemicals that are designed to resist degradation by microbes. The above mentioned results, as well as the fact that registration of antibiotic-producing products is discouraged because of possible cross-resistance with antibiotics applied for human and animal use, suggest that biocontrol strains based on mechanisms other than antibiosis might have a better future for surviving the registration procedure and therefore becoming a product. PGPR have gained worldwide importance and considered as important tools in sustainable agriculture due to their plant growth promotional ability as well as bio-control potential because they can reduce harm caused by pathogens and therefore can be potentially utilized as biopesticides.

## II. Concept of Biological Control

The terms "biological control" and its abbreviated synonym "biocontrol" have been used in different fields of biology, most notably entomology and plant pathology. In entomology, it has been used to

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describe the use of live predatory insects, entomopathogenic nematodes, or microbial pathogens to suppress populations of different pest insects. In plant pathology, the term applies to the use of microbial antagonists to suppress diseases as well as the use of host-specific pathogens to control weed populations. In both fields, the organism that suppresses the pest or pathogen is referred to as the biological control agent (BCA).

## III. Plant Growth Promoting Rhizobacteria as Biological Control Agent (BCA)

The use of PGPR offers an attractive way to replace chemical fertilizer, pesticides, and supplements; most of the isolates result in a significant increase in biological control agents. PGPR is gaining momemtum in the weed control in crop fields. Antibiotics identified in antagonistic gram negative biocontrol bacteria include the classical compounds HCN (Haas D, Keel C. 2003) which is a volatile compound suppressor of weeds. It is noted that some rhizobacteria are also active against weeds (Flores-Fargas RD and O'Hara GW. 2006) and insects ( P´echy-Tarr M, *et al.* 2008), *Meloydogyne incognita* (Siddiqui A, Haas D, Heeb S. 2005), Carabid beetles such as *Harpalus pensylvanicus* are common in many crop fields and can eat and destroy large numbers of weed seeds. Natural enemies of weeds are often present naturally in crop fields.

## IV. Hydrogen Cyanide a Promising Secondary Metabolites of Plant Growth Promoting Rhizobacteria as Biocontrol Tools

One group of microorganisms which acts as biocontrol agents against weeds include the Deleterious Rhizobacteria (DRB) that can colonize plant root surfaces (Suslow TV and Schroth MN, 1982). Many Deleterious Rhizobacteria Bacteria are plant specific (Schippers B, *et al*, 1987). Cyanide is a dreaded chemical produced by them as it has toxic properties. Although cyanide acts as a general metabolic inhibitor, it is synthesized, excreted and metabolized by hundreds of organisms, including bacteria, algae, fungi, plants, and insects, as a mean to avoid predation or competition. The host plants are generally not negatively affected by inoculation with cyanide producing bacterial strains and host-specific rhizobacteria can act as biological weed-control agents (Zeller SL *et al*, 2007). A secondary metabolite produced commonly by rhizosphere pseudomonads is Hydrogen Cyanide (HCN), a gas known to negatively affect root metabolism and root growth (Schippers B, *et al,* 1990) and is a potential and environmentally compatible mechanism for biological control of weeds (Heydari S, *et al*, 2008). The HCN production is found to be a common trait of *Pseudomonas* (88.89%) and Bacillus (50%) in the rhizospheric soil and plant root nodules (Ahmad F, *et al*, 2009) and is a serious environmental pollutant and a biocontrol metabolite in *Pseudomonas* species. Advancement of HCN potential in weed control, depth investigation (Castric PA, 1977) was carried out to enhance the HCN activity. But role of glycine is documented in biocontrol. It was previously not known if glycine was a carbon precursor for HCN in *Pseudomonas aeruginosa*. Castric presented evidence that glycine is an HCN precursor for P. *aeruginosa*, but that this process differs significantly from cyanogenesis in other bacteria because: (i) other amino acids besides glycine stimulate HCN production; and (ii) both carbons of glycine are used as sources of cyanide carbon. The level of HCN produced in root-free soil by P. *putida* and A. *delafieldii* generally increased with higher amounts of supplemental glycine, with P. *putida* typically generating more HCN (8–38 µM) at a given glycine level (Owen A, Zdor R, 2001). The sorghum seedlings [*Sorghum bicolor* (L) Moench] of different genotypes differ in associations with soil microorganisms and differentially affect the number of FLPs in cropping systems (Funnell-Harris DL, 2008). Some of the recent studies have indicated that and some of the Pseudomonas spp. metabolites such as HCN may enhance plant establishment. Wani *et al.* (Wani PA, 2007) tested the rhizosphere isolates for HCN producing ability *in vitro* to find that most of the isolates produced HCN and helped in the plant growth. The isolates from the rhizospheric soil of chickpea also exhibits more than two or three PGPR traits including HCN production, which promotes plant growth directly or indirectly or synergistically. The rhizosphere competent *Mesorhizobiumloti* MP6 produces hydrocyanic acid (HCN) under normal growth conditions and enhances the growth of Indian mustard (*Brassica campestris*) (Chandra S, 2007). Bacterial isolates belonging to genera *Bacillus* and *Pseudomonas* isolated from rhizospheric soils of mustard produces HCN and application of herbicides (quizalafop-p-ethyl & clodinafop) do not have any significant change in HCN production by these isolates (Munees A and Mohammad SK, 2009]. The entomopathogenic bacterium *Pseudomonas entomophila* produces HCN which is a secondary metabolite and is implicated in biocontrol properties and pathogenicity exerted by other bacteria (Ryall B, *et al* 2009). The Pseudomonas fragi CS11RH1 (MTCC 8984), a psychrotolerant bacterium produces hydrogen cyanide (HCN) and the seed bacterization with the isolate significantly increases the percent germination, rate of germination, plant biomass and nutrient uptake of wheat seedlings (Selvakumar, G, *et al*, 2008). Other microbial byproducts also may contribute to pathogen suppression. Hydrogen cyanide (HCN) effectively blocks the cytochrome oxidase pathway and is highly toxic to all aerobic microorganisms at pico-molar concentrations. The production of HCN by certain fluorescent pseudomonads is believed to be involved in the suppression of root pathogens. P. *fluorescens* CHA0 produces antibiotics, siderophores and HCN, but suppression of black rot of tobacco caused by *Thielaviopsis basicola* appeared to be due primarily to HCN production (Voisard et al. 1989). While it is clear that biocontrol microbes can release many different compounds into their surrounding environment, the types and amounts produced in natural systems in the presence and absence of plant disease have not been well documented and this remains a frontier for discovery.

## V. Conclusion

Introduction of PGPR into agricultural practices could minimize use of toxic chemicals noxious to the environment, thus contributing to the development of sustainable agriculture. Growers can reduced dependence on chemical inputs, so biological controls can be expected to play an important role in Integrated Weed Management (IWM) systems. Despite a model describing for a successful IPM has been developed such as Good cultural practices, including appropriate site selection, crop rotations, tillage, fertility and water management, provide the foundation for successful pest management by providing a fertile growing environment for the crop has to be considered. PGPB offer an attractive alternative that contains the possibility of developing more sustainable approaches to agriculture. Finally, it is likely to be much simpler and more efficacious to select or engineer PGPB so that they confer plants with specific desirable traits than to genetically engineer the strain to developed performance in field. Further compactible study should be study with herbicide, so that PGPR can be used as consortia formulation with pesticides.

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