MANAGEMENT OF *PARTHENIUM* IN AGRICULTURE

“Manuring profiteth more than the ploughing and when land is weeded, guarding profiteth more than irrigation”.

-Tamil poet and seer, Tiruvalluvar.

5.1. INTRODUCTION:

*Parthenium hysterophorus* L. is also known as congress weed, star weed, carrot weed, white top, white head, bitter weed, broom bush and false ragweed. Initially, this species has been confined to roadside, railway track, wasteland and non-cropped areas, but it started colonizing cropping lands very rapidly. In India, it has been moved from roadside to adjoining fields of sugarcane, rice, vegetables and pastures.

5.1.1. Origin and distribution -

The obnoxious weed *Parthenium* occurs naturally throughout the tropical and subtropical Americas from southern United States of America (USA) to southern Brazil and northern Argentina (Dale, 1981). In India, its first reported incidence was in the mid 1950s (Chandras and Vartak, 1970), is one of the most feared noxious weed species (Rao, 1956) and has since been spread over most parts of the Indian sub-continent. It was reported to infest more than 2 million hectares in 1991 and now it is covering about 10 million hectares of land (Sushilkumar, 2005). *Parthenium* was first noticed near Poona (M.S.) in 1951.

5.1.2. Weed status -

The weed indeed, no mention is made of it in the classic treatise on the ‘World’s Worst Weeds’ (Holm *et al*., 1977). But within last ten years, it has become one of the seven most dangerous weeds of the world (Singla, 1992). At present, *Parthenium* is considered as an invasive weed due to its prolific seed production, rapid spreading...
ability, allelopathic effect on other plants, higher phenotypic plasticity, ability to tolerate wide range of environmental conditions and health hazard to human as well as animals.

5.1.3. Weed biology -

*Parthenium* is a herbaceous annual or ephemeral member of the family Asteraceae (Compositae), reaching a height of 2 m when growing in good quality soil and flowering within 4 to 6 weeks of germination (Navie *et al.*, 1996). Large plants can produce more than 15,000 seeds, which may be distributed by wind, water, animals or vehicles (Auld *et al.*, 1983). It has been thought that most of the seeds germinate within 2 years, if conditions are suitable (Butler, 1984), although a portion of buried seeds may remain viable for several years (Navie *et al.*, 1998a). *Parthenium* weed grows best on alkaline to neutral clay soils (Dale, 1981), but grows less prolifically on a wide range of soil types. The water requirements of the plant are relatively high and both germination and growth are limited by poor rainfall (Williams and Groves, 1980). It can tolerate drought condition also to a certain extent. Under favourable circumstances, *Parthenium* completes about three generations in a year. It is also reported that *Parthenium* weed has remarkable power of regeneration. The stumps of the plant left after cutting, sprout back producing a large number of shoots from latent crown buds. Flowers are produced on such shoots within thirty days (Dhawan and Dhawan, 1996).

5.1.4. Weed problems -

The infestation level is predominantly very high in Australia and India. In addition to the reduction in land productivity, yield decline to an extend 40 % in agricultural crops (Khosla and Sotbi, 1981) and 90 % in forage production has been reported (Nath, 1988; Mahadevappa *et al.*, 2001). In our country 4 - 7 % of human population suffers from familiar clinical symptoms while 42 to 50 % are sensitized without showing symptoms (Towers and Subba Rao, 1992). *Parthenium* weed is generally unpalatable, but cattle and sheep will eat it when feed is scarce. This species reduces the carrying ability of the grazing and significantly and adversely affects animal health, milk and meat quality. Consumption of huge amounts will create taints in mutton (Tudor *et al.*, 1982) or kill the stock. *Parthenium* is spreading at the exclusion of native plants and changing the plant species composition by reducing natural plant wealth and biodiversity (Batish *et al.*, 2004). The weed is considered a major problem in India (Gupta and Sharma, 1977; Shelke, 1984) and now is attracting the attention of all.
5.1.5 Weed management -

The control of this weed is quite difficult, primarily due to its invasive nature, strong reproductive and regenerative potential. Studies to utilize this problematic weed efficiently for human welfare are lacking. Despite serious negative traits enumerated above, it has been shown that *Parthenium* could be put to more than one use. The potential uses include making of green leaf manure, compost, vermicompost or any soil amendment. Organic recycling of this weed not only manages the world’s most hazardous weed but also provides returns in the form of manures. One of the beneficial methods for management of *Parthenium* is preparation of different types of manures. In this investigation, attempts have been made to see the feasibility of *Parthenium* weed manures on the growth and yield of maize as an indicator crop.

5.2. MATERIALS AND METHODS:

5.2.1. Field site and experimental design -

A field experiment was conducted in the Research farm of Dr. Babasaheb Ambedkar Marathwada University’s Botanical garden during Oct. 2003 to Jan. 2004. The experimental design was a randomized block design (RBD) with six treatments and four replications.

5.2.2. Treatments, composting process and plot size -

The fresh green leafy vegetation of *Parthenium* was collected from different sites of University campus during the early hours of the day at 10 - 20 % flowering stage and brought to laboratory, chopped into small bits (2 - 3 cm) by the traditional iron cutter (wili). The weed plant material was incorporated into the plots at the rate of 13333 kg ha\(^{-1}\) about 15 - 20 cm deep in the soil as green manure (GM). The same amount of vegetation was used for the preparation of compost (CM), vermicompost (VM) and kept for drying as dry leaf manure (DM). The known weights of plant material were evenly spread in the trenches for compost and vermicompost to a thickness of about 5 cm. Above each layer, 5 % dung slurry and soil added alternately and afterward water was sprinkled in order to maintain the optimal moisture (50 - 70 \%) over the material. This procedure was repeated until the composting materials were used. Finally, the pits were closed with cow dung slurry and fine clay to prevent loss of heat or exchange of gases and anaerobic decomposition commences. After 18 d (partial decomposition), main species of earthworm *Eudrilus eugeniae* Kinberg that are also known as red variety (90
individuals per pit) was released into the vermicomposting pit only and within 17 d a good quality compost was obtained. The manures (after 35 d) were applied to appropriate plots including fertilized (100 % NPK) and unfertilized checks. The samples (100 g) of each treatment were randomly collected immediately in duplicate before materials were applied to the plots and kept in oven at 90°C (48 h) for dry weight and nutrient analyses. The results of organic amendments are summarized in Tables 1 and 2. The maize (*Zea mays* L. cv. African Tall) produced by Mahendra Hybrid Seeds Co. Ltd., Jalna was planted at the rate of 100 kg ha⁻¹. Plots consisted of nine rows spaced 30 cm apart and with the size 3 x 3 m². In order to ensure uniform population density and plant-to-plant spacing within a row per plot, either transplanting extra seedlings or thinning in the dense population area was done.

5.2.3. Applications of mineral fertilizers -

The fertilizers were supplied as nitrogen (N), phosphorus (P) and potassium (K) through urea, single super phosphate (SSP) and muriate of potash at the rate of 120, 80 and 40 kg ha⁻¹. Entire amount of P and K was applied as basal dose to all the amendments except absolute CO at the time of sowing and N was given in two equal split dressings at 57 and 89 days after sowing (DAS) for sole application of FE treatment. The crop received supplemental irrigation during periods of low rainfall and whenever necessary, weeding was done by hand through khurapi and uses of insecticides or pesticides were avoided.

5.2.4. Plant sampling -

The green foliage was harvested during the early hours of the day at vegetative stage (102 DAS). The fodder yield obtained per plot was recorded on the field itself (Davys and Pirie, 1969) and samples from each plot (100 gm plot⁻¹) were immediately collected. The samples were oven dried at 80°C for 2 d to constant weight and loss in weight was determined. The dried samples were ground, passed through 0.5 mm sieve and stored in sealed polythene bags for nutrients analyses.

5.3. ANALYSES:

5.3.1. Growth analyses -

The morph-physiological traits of the crop were noted at 70 and 100 DAS as plant height, diameter, number of leaves per plant, fresh weight of root, stem, leaves and total
weight, 4th upper leaf length, its width and weight and leaf area per plant was determined by gravimetric method (Shahane and Mungikar, 1984; Mungikar, 1986).

5.3.2. Chemical analyses -

The chemical analyses were done by adopting standard analytical methods. Organic matter was determined by rapid titration method (Walkley and Black, 1934). The leaf chlorophyll contents (a, b and total) were estimated following Yoshida et al., (1976), using 80 % acetone as a solvent for extraction of pigments. Ash values were obtained by heating the moisture-free samples in a muffle furnace at 600°C for 2 hours and calcium (Ca) content was analyzed by titrating the sample against 0.01 N KMnO₄ solution using methyl red as indicator (AOAC, 1995). Nitrogen (N) was estimated by micro-Kjeldahl method after digesting the sample with Conc. H₂SO₄ (Bailey, 1967) and crude protein (CP) was then calculated by multiplying N value with 6.25 as specified by AOAC, (1995). Reducing sugar (RS) was determined by reacting the sample with phosphomolybdic acid at 420 nm and phosphorus (P) was analyzed by reacting the sample with ammonium molybdate solution at 660 nm (Oser, 1979) and potassium (K) content was determined on a flame photometer (model Mediflame- 127) as suggested by Jackson (1973).

5.3.3. Statistical analysis -

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (CD, P≤0.05) which allowed determination of significance between different applications (Mungikar, 1997).
Chapter 5
Management of Parthenium in agriculture

<table>
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<td>02</td>
<td>Preparation of manures</td>
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<td>Treatments applied to the plots</td>
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<td>05</td>
<td>Basal dose of P and K</td>
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RANDOMISED BLOCK DESIGN:

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5.4. RESULTS AND DISCUSSION:

5.4.1. Growth analyses -

The growth analyses of maize crop were done at 70 and 100 DAS (Tables 3 and 4). During the first growth analyses, the tallest plant was obtained with the fertilization of GM treatment followed in order by VM, CM, DM and FE over the CO plots where soil available nutrients were not adequate to meet the crop demand (Table 3). This trend was observed with respect to diameter, total fresh weight of plant, 4th upper leaf length and leaf area. The root weight was greater in the GM amendment followed by VM, DM, CM and FE applications and least in unfertilized plots. The width of 4th upper leaf was higher with FE treatment and fresh weight was more in the GM treated plots than that of all the other amendments (Table 3).

In the second growth analyses also, the highest plant was recorded in the GM followed by VM, CM, DM and FE treatments and lowest in untreated plots (Table 4). The same pattern was observed in respect of diameter, fresh weight of stem, leaves and total and in all the parameters of 4th upper leaf and leaf area while the fresh weight of root was maximum in the plots amended with GM as compared to remaining treatments (Table 4).

5.4.2. Chlorophyll contents -

The mean values for chlorophyll contents (a, b and total) of maize ranged from 0.71 - 1.84, 0.37 - 0.77 and 1.08 - 2.61 mg g\(^{-1}\) leaf fresh weight (fw) during first growth analysis (Fig. 1) and in the second growth analysis varied from 0.58 - 2.17, 0.30 - 1.14 and 0.89 - 3.31 mg g\(^{-1}\) fw (Fig. 2). The chlorophyll contents were highest in all manure based amendments as compared to reference CO. Among them, chlorophyll a, b and total chlorophyll were maximum in GM received plots during both the growth analyses (Figs. 1 and 2). Total chlorophyll content plays a significant role in the production of total biomass and productivity of the crops.

5.4.3. Analyses of maize plant and crop -

a) Analyses of root:

The fresh weight of root was highest in the plots receiving GM followed in order by CM, VM, DM and FE treatments in comparison with CO plots (Table 5). However,
analagous results were observed in respect of dry matter, N and total RS. The CP was maximum in GM and CM amendments followed by VM and DM applications and minimum in CO than that of fertilized plots. The P and Ca contents were more in all the weed manure and FE treatments as compared to absolute control where as the percent of K was high with the VM and afterwards in CM treatments than that of other manures and fertilizer alone applications (Table 5).

b) Analyses of stem:

The highest fresh weight of stem was accounted for GM treated soil followed in order by VM, CM and DM treatments and lowest in the FE and CO plots (Table 6). A similar trend was observed with respect to dry matter and RS. The N and CP were maximum in GM followed by CM, VM and DM amendments and minimum in CO than those of FE treatment. The percent of P was higher in the plots based with CM and then in FE applications as compared to other treatments. The K and Ca contents were superior in all the amendments apart from the unfertilized plots with the exception of K where the VM treated plots showed lowest percentage (Table 6).

c) Analyses of leaves:

The fresh weight of leaves was higher in the GM amended plots followed in order by VM, CM, DM and FE treatments and lower in un-amended soil (Table 7). The dry matter and RS behaved in the similar manner in this regard. The N and CP were more for GM followed by CM, VM and DM amendments than that of FE alone and CO treatments. Also, the same trend was observed in respect of Ca content. The percent of P and K were high in plots based with DM treatment and least in absolute CO (Table 7).

d) Analyses of maize crop -

The average yield of fresh aerial biomass and dry matter of maize was highest in the plots received with GM amendment followed in order by VM, CM DM, FE and lowest in unfertilized treatment (Table 8). The N and CP contents were maximum in the VM followed by CM, GM, DM and FE treatments over the CO plots. Almost similar trend was observed with respect to total RS. The P was greater for CM based application followed in order by VM, FE, GM and least in un-manured plots than that of DM. The percent of K was more in the CM amendment and afterward in GM where as the Ca was higher with VM and DM fertilized plots as compared to all the other treatments and less in total CO (Table 8).
e) Percent increase over CO and N efficiency ratio -

The percent increase over CO for fresh weight and dry matter was maximum with the fertilization of GM followed in order by VM, CM, DM treatments and minimum in FE applied plots (Fig. 3) while the nitrogen efficiency ratio for fresh vegetation and dry matter was highest in the plots treated with VM followed by CM, DM and GM applications than in FE alone treatment where N was supplied through urea (Fig. 4).

All the results are calculated on dry matter basis and the values are the means of four replicates. These results are statistically significant over the control with the exceptions of leaf area, root fresh weight and CP, stem fresh weight and dry matter and leaves dry matter in sole FE application and also in P content in DM and percent of K in VM treatment of stem.

Based on the results, it is obvious that the growth and yield of maize increased significantly due to the application of organic manures in combination with inorganic fertilizers because of the better uptake of nutrients from the soil. Organic manuring along with application of fertilizers helps to release nutrient elements slowly and steadily during the period of crop growth.

5.5. CONCLUSION:

On the basis of the results obtained, it can be concluded that the combined application of green manure (GM) and chemical fertilizers was more effective in increasing the growth, nutrient uptake and yield without any detrimental effect on maize crop. As compared to other manuring methods, green manure is the best, active and cheapest source of plant nutrients working with high efficiency. This practice will certainly lower the menace of Parthenium weed and reduce the ill effects of this weed in agriculture and social life. These results are in agreement with the findings of Aktar et al., (1993) and Kolhe and Bhamtri (2005).
References:


