Pak. J. Weed Sci. Res., 21(4): 505-516, 2015

PARTHENIUM WEED COMPOST: AN ENVIRONMENT FRIENDLY WAY OF ITS CONTROL AND TO HARNESS ITS ALLELOPATHIC EFFECT

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ABSTRACT

Profitable and environment friendly management of parthenium weed through composting and subsequent utilization as nutrient option alone or in combination with other nutrient sources was studied on chili crop in District Nowshera, Pakistan during 2013 crop season. Six treatments; the control, N:P_2O_5:K_2O (60:60:30 kg ha^{-1}), Farmyard manure (FYM, 10 t ha^{-1}), parthenium weed compost (PWC, 10 t ha^{-1}), 50% FYM+50% NPK and 50% PWC+50% NPK were arranged in randomized complete block design (RCBD) with 2 m^2 treatment plot size each one replicated three times. Results showed that initially (40 days after transplant) weed density decreased with nutrients application from all sources and amongst the organic sources, the parthenium weed compost (PWC) showed 72% and farmyard manure (FYM) showed 23% reduction in weed density over the control. At the middle of the growth period of the crop (80 days after transplant), FYM recorded 53% higher weed density over the control and 46% higher over the PWC. At maturity of the crop (120 days after transplant), weed density in FYM was again the maximum (23% higher over the control). On the other hand, PWC showed 39 and 13% and 50% PWC + 50% NPK showed 37 and 12% reduced weed density over the FYM and the control, respectively). Weed fresh and dry biomass were initially higher in the control but at the middle of the growth stages of the crop and at maturity, the FYM showed fresh biomass by 89, 62 and 110% and dry biomass by 123, 76 and 79% higher over the PWC, 50% PWC+50% NPK and the control, respectively. At maturity of the crop, same trend for fresh and dry weed biomass was observed but the chili total yield was observed to be 4 times higher in 50% PWC+50% NPK and 2.4 times higher in the PWC treatments over the

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FYM. The study concluded that 50% PWC+50% NPK showed significant reduction of weeds as well as increase in chilli fruit yield and is recommended as a nutrient source and profitable management strategy of parthenium weed.

Key words: Chilies, growth, parthenium, weed compost, weeds, weed density.

Citation: Ahmad, W., S. Hussain, W. Malik, I. Ahmad, M.A. Jadoon, F. Munsif, I. Khan and R.U. Shah. 2015. Parthenium weed compost: an environment friendly way of its control and to harness its allelopathic effect. Pak. J. Weed Sci. Res. 21(4): 505-516.

INTRODUCTION

Chili (*Capsicum annum* L.) is a semi-perennial crop but it is grown as annuals by the conventional farmers in Pakistan. They are a good source of carbohydrates, vitamin A and vitamin C (Burt *et al.*, 2005). In Pakistan, two varieties of chilies namely; *Capsicum annum* and *Capsicum frutescence* are important vegetable, used both as salad and as dried condiments (Govt. of Pakistan, 2006-07). It average cropping occupies 73.8 thousand hectare in Pakistan with total production of 90,000 tonnes thereby providing 1.5% share in the country's GDP (Govt. of Pakistan, 2008-09).

There are some reasons due to which chilli crop yield is low in Pakistan but most of our farmers are unaware regarding such limitations (Qureshi and Bhatti, 2001). Weed infestation is one among them which compete with the crop plants for food, moisture; sun light, CO_2 and space, as well as many weeds also possess allelopathic effects against crops. Different environmental conditions in different regions determine the specific weed spectrum, composition and population (Memon *et al.*, 2007). Reduction in yield due to weed crop competition mainly depends on weed species and their densities as well as crop types. As the distribution and infestation intensity of each varies, the extent of reduction in crop yield mainly depends on the number and kind of weeds found in the field (Frisbie *et al.*, 1989).

Many plants species occurring in Pakistan possess allelopathic attributes that could successfully be utalised for weed control in agricultural crops (Khan *et al.*, 2011). There might have various physiological target sites for their allelochemicals among which some known sites are cell division, pollen germination, nutrients uptake, photosynthesis and specific enzyme function (Noor *et al.*, 2012). Parthenium (*parthenium hysteropohrus* L.) is one such weed who's allelopathic properties and ability to inhibit the growth and development of other species is well documented (Kanchan and

Jayachandra 1980; Tefera 2002). It grows luxuriously in wastelands, agricultural areas and roadsides (Tefera, 2002), and in areas where the annual rainfall is greater than 500 mm. The allelo chemicals released from parthenium are sesquiterpene lactones and phenolics (Swaminathan *et al.*, 1990). Parthenin is the major sesquiterpene lactone whereas caffeic, vanillic, ferulic, chlorogenic and anisic acids are the major phenolics (Kanchan and Jayachandra, 1980; Batish *et al.*, 2002; Singh *et al.*, 2002). These two synergistically acting groups of allelo chemicals significantly decrease the germination and growth in many crops (Batish *et al.*, 2005a; Singh *et al.*, 2003). Deducing from the results of these previous workers, it was hypothesised that parthenium weed incorporation in soil as part of compost, might retain the same allelopethic properties for other weeds and its incorporation is soil could be a profitable option as nutrient source as well as in weeds management. Due to lack of sufficient information on the effectiveness of parthenium weed compost, the present study was designed with the objective of testing the parthenium weed compost for its effectiveness as nutrient source as well as weeds management option in chili crop.

MATERIALS AND METHODS

The experiment was conducted farmer's field to study the effect of parthenium weed compost in comparison with farmyard manure (FYM) and NPK on the occurrence of weed biota and yield parameters in chilies (*Capsicum annum* L.) A farmer's field with a history of low chillies fruit yield was selected for the study in village Zande Banda Chail, (34° 07' 684" N, and 71° 54' 253" E) Kheshgi Bala, Nowshera (Khyber Pakhtunkhwa, Pakistan) during 2013. The experiment was laid out in randomized complete block design (RCBD) with a 2 m^2 sub-plot size each one replicated three times. A total of six treatments namely 1) Control, (2) N: P_2O_5:K_2O (60:60:30 kg ha^{-1}), (3) Farmyard manure (FYM, 10 t ha^{-1}), (4) parthenium weed compost (PWC, 10 t ha^{-1}), (5) 50% FYM+50% NPK and (6) 50% PWC+50% NPK were studied. Young healthy chilli seedlings were transplanted in March 2013 with plant to plant distance of 30 cm and row to row distance of 60 cm. The sources inorganic fertilizers for N, P_2O_5 and K_2O were Urea, DAP and Murat of Potash (MOP), respectively. The FYM obtained from a local farmer whilst parthenium weed compost was prepared in the Palattoo research farm of the University of Agriculture, Amir Muhammad Khan Campus Mardan and both these organic sources were applied 15 days before transplantiion of chillies seedlings. Plants were irrigated as and when needed. The following parameters were recorded.

Weeds fresh and dry weight was recorded using electronic balance and weeds density per square meter was measured in each treatment at equal interval of 40, 80 and 120 days after transplanting (Khan *et al.*, 2012). Chilies yield was also measured in each treatment with the help of electronic balance throughout the season when fruits developed to the maximum (Khan *et al.*, 2012). Plant fresh and dry biomass was also measured after 120 days of transplant when plants were uprooted using electronic balance as was done by Deore *et al.* (2010).

Statistical analysis

The data was analyzed through analysis of variance (ANOVA) procedure for randomized complete block design (Gomez and Gomez 1984) using MSTATC, MS Excel and Statistix softwares and the variations amongst the treatments were compared through LSD-test of significance at the p level of $p<0.05$ and $p<0.01$ (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Weeds density

Weed density (WD) was significantly ($P<0.05$) different among the treatments at all three intervals (40, 80 and 120 days) after transplanting of chili seedlings (Table-4). Results showed that initially (40 days after transplanting) WD was the highest (49.33 m^{-2}) in control treatment and the application of nutrients from different sources recorded a reduced WD by 97, 72, 23, 44 and 10% in the NPK, parthenium weed compost (PWC), farmyard manure (FYM), 50% PWC+50% NPK and 50% FYM+50% NPK treatments, respectively. At the same time PWC recorded 72% while 50% PWC+ 50% NPK recorded 44% reduced WD over the control. Surprisingly and as against Arif et. al. (2013), the lowest WD during the initial growth stages was observed in the NPK alone treatment (25 m^{-2}) that was 97% lower over the control. The plausible reason for this might be the immediate availability of NPK nutrients to the crop plants in the NPK treated plots helping in their establishment and luxurious growth and causing the suppression of weeds under their shading effect. Results further showed that FYM manure treatments showed the minimum reduction in weed density that were 23 and 10% in the sole FYM and 50% FYM+50% NPK, respectively over the control probably due to poor crop growth in these treatments. At the middle of the growth stage (80 days after transplanting), the FYM alone treatment recorded the highest WD (132 m^{-2}) that was 53% higher over the control, 46% higher over the PWC, 20% higher over the NPK , 18% higher over the 50% PWC+50% NPK and 8% higher over the 50% FYM+50% PWC treatment. These results indicated that raw FYM could be the source of a number of weed seeds as without composting these seed remain alive in the FYM and when applied, they germinated profusely in the

FYM treated plots. Arif *et al*. (2013) support these results stating that FYM application increased weed infestation in wheat crop. Contrary to FYM, the PWC could have a two fringed action on weeds i.e inactivation/burning of their seeds due to high temperature during composting process and the herbicidal and allelopathic action of the parthenium component therein. When measured at maturity of the crop (120 days after transplanting), the highest WD (117.67 m^{-2}) was noted in the FYM alone (Arif et. al., 2013), which was 40, 62, 38, 12 and 23% higher over the plots treated with the PWC, NPK, 50% PWC+ 50% NPK, 50% FYM+ 50% NPK and the control , respectively. Similar to these findings, Ambasta and Kumari (2013) also showed a 40% reduction in WD due parthenium weed compost application. These results correlate well with the poor performance of the crop in the raw FYM manure treated plots (Figure 1) resulting in poor shadowing effect and profuse weed growth.

Table-1. Weeds density at 40, 80 and 120 days of transplanting

Treatment	40 days	80 days	120 days
Control	49.3 a	086.3 d	095.3 c
NPK	25.0 e	109.7 c	072.7 e
Compost	28.7 e	090.3 d	084.0 d
FYM	40.0 c	132.0 a	117.7 a
50%compost+50%NPK	34.3 d	112.3 c	085.0 d
50%FYM+50%NPK	44.7 b	121.7 b	104.7 b
LSD ($p<0.05$)	4.45	7.42	5.91

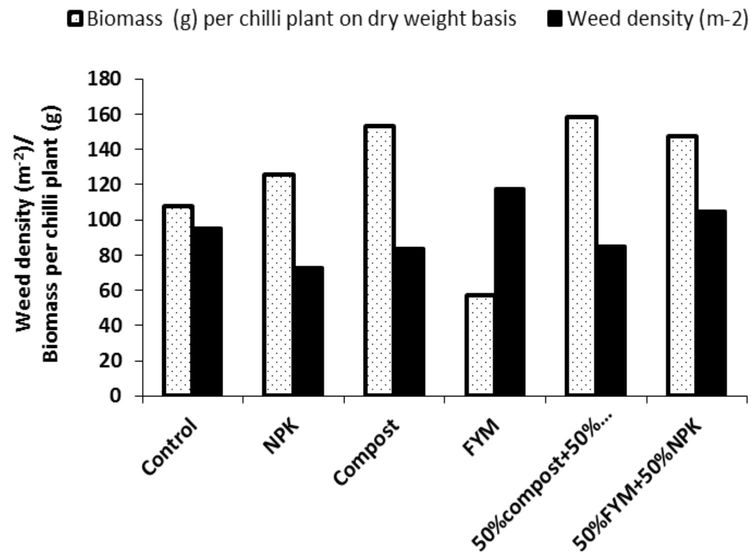

Figure 1. Weed density and biomass per plant as affected by nutrient sources

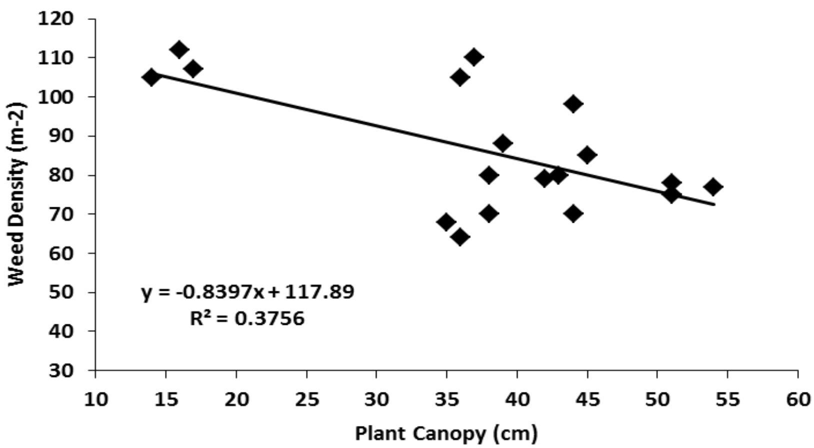

Figure 2. Correlation between weed density and chili plant canopy

Weed biomass yield

Statistical analysis of the data showed that treatment effect on both weeds fresh biomass (WFB) and weeds dry biomass (WDB) was highly significant ($P<0.01$) at the 40, 80 and 120 days after transplant. At the 40th day after transplant, the control treatment produced the highest WFB (213.5 kg ha^{-1}). Application of nutrients irrespective of their sources showed a suppressive effect on WFB with

162, 128, 51, 32 and 13% reduction in the NPK, PWC,, 50% PWC+50% NPK, 50% FYM+50% NPK and the FYM alone treatments, respectively (Table-2). These results indicated that application of nutrients have improved the crop stand that have either directly suppressed the weeds under their shadowing effect or indirectly through their root proliferation. Therefore, the maximum reduction in WFB is evident in the NPK treated plots followed by PWC and 50% PWC+50% NPK. The minimum reduction in WFB in FYM treatment is attributed to poor crop stand thereby allowing maximum weed growth. The same trend was observed for WDB after 40 days of transplant which showed 138, 95, 55, 36 and 13% reduction in the NPK, PWC, 50% PWC+50% NPK, 50% FYM+50% NPK and the FYM alone treatments, respectively, over the control (Table-2) and therefore, confirming the results obtained on WFB at 40 days interval after transplant.

At the 80th day after transplant, the lowest WFB (6.32 t ha^{-1}) was recorded in control treatment which might be due to the exhaustion of available nutrients as compared to other treatments that were applied with nutrients either in one form or the other. Results showed the highest WFB in the FYM alone plot which was 110 % higher over the control. This might be due to two reasons; a number of unfermented weed seeds applied along with FYM and the nutrients availability to weed from FYM decomposition for a longer time. The plots treated with NPK, PWC, 50% PWC+50% NPK and 50% FYM + 50% NPK recorded 79, 89, 62 and 13% lower WFB yield over the FYM alone indicating the superiority of PWC either alone or in combination with NPK in the reduction to WFB thereby ensuring improved chili yield as compared to other treatments (Fig. 3). Similar trend in WDB was observed after 80 days of transplant where the PWC recorded 123% lower WDB as compared to the maximum in FYM alone treatment (4.63 t ha^{-1}). In the FYM treated plot, WDB was 80% higher over the control, 76% higher over the 50% PWC+50% NPK, 57% higher over the NPK and 2% higher over the 50% FYM+ NPK treatments (Table 2). The highest WDB in the FYM treatment correlates well with its WFB. The lowest WDB in the compost and the 50% compost+50% NPK treatment might partly be due to decomposition of weed seeds in the compost owing to its high temperature during composting process and partly due to the allelopathic effect of the allelochemicals present in the parthenium component of the compost.

Table-2. Weeds fresh and dry biomass at 40, 80 and 120 days of transplanting in kg ha^{-1}

Treatment	Fresh wt	dry wt	Fresh wt	dry wt	Fresh wt	dry wt
	40 days		80 days		120 days	
Control	213 a	75 a	6316 b	2575 b	4620 b	1270 c
NPK	81 d	31 b	7410 b	2945 b	4146 b	1223 c
Compost	93 cd	38 b	7025 b	2080 b	4248 b	1468 bc
FYM	188 ab	66 a	13286 a	4628 a	6006 a	1760 ab
50%compost+ 50%NPK	141 bc	48 ab	8216 b	2625 b	4631 b	1351 c
50%FYM+ 50%NPK	161 ab	55 ab	11751a	4536 a	5695 a	1910 a
LSD (p<0.05)	12.0	6.2	738.3	215	212.8	92.8

Wt: weight

At the 120 days after transplant, it was observed that lowest WFB (4.15 t ha^{-1}) was recorded in the plot treated with NPK which might be due to the exhaustion of all the nutrients applied in the NPK plots by that time. Following the NPK treatment, the compost showed the second lowest in WFB (4.25 t ha^{-1}) which might be due the allelopathic effect of the parthenium component in the compost. These results are in line with those of Ambasta and Kumari (2013) stating that parthenium weed compost reduced the weed growth by 40% in maize due to allelopathic effect. Here again the highest WFB (6 t ha^{-1}) was recorded in plots treated with FYM alone which was 45, 41, 30 and 29% higher over the NPK, PWC, 50% PWC+50% NPK and the control treatments, respectively, and only 5.4% higher over the 50% FYM+50% NPK treatment. At the 120 days after transplanting significantly (P<0.05) low (1.22 t ha^{-1}) WDB was recorded in NPK treated plot which gave an evidence that by the 120th day, all of the applied NPK had been exhausted. On the other hand, the highest WDB (1.9 t ha^{-1}) was recorded in the 50% FYM+50% NPK which was 36% higher over NPK treatment and this gave an evidence that raw FYM, being a source of weed seeds, might be a source of nutrients for nourishing these weeds upto the end of crop seasons.

Chilies yield

Statistical analysis of the data showed that nutrients application through different sources significantly (P<0.01) affected chillies yield. Results (Fig. 3) showed that the highest chilli fruits yield (3626.7 kg ha^{-1}) was recorded in plots treated with 50% PWC+50% NPK, which was 4 times higher than the plots treated with FYM alone recording the lowest chilies yield (736.7 kg ha^{-1}) whilst the PWC alone treatment recorded 2.4 times higher chili fruits yield over the FYM alone treatment. Chavan *et al.* (1997) found that combined application of nitrogen through FYM and urea was more beneficial as compared to fertilizer alone in order to increase the yield and quality of chilies. Yet he also recommended that the inorganic fertilizer (NPK) in combination with bio compost is suitable for better production of chilies that might increase soil fertility and this integrated approach could contribute to improve crop production. Kale and Bano (1994) observed in sunflower (cv.EC 68415 and Morden) that at par seed yields were obtained by the application of both 50% vermicompost with 50% recommended dose of chemical fertilizers or full dose of FYM and vermicompost. But these two treatments were significantly superior over application of lower dose of FYM or vermicompost with reduced dose of chemical fertilizers. According to Subbaiah *et al.* (1982), the combined application of organic and inorganic fertilizers was highly beneficial in increasing the yield level of chilies as compared to fertilizers alone. This increased yield level is attributed to the solubilisation effect of plant nutrients due to the addition of FYM. Subbaiah *et al.* (1985) observed that the combined application of FYM and inorganic fertilizers to improve the yield of tomato and brinjal was the best combination of 30 t ha^{-1} FYM and 100:100:100 NPK kg ha^{-1}. Damke *et al.* (1988) observed highest chillies yield with application of FYM at 9 t ha^{-1} along with 50 kg ha^{-1} each of N, P_2O_5 and K_2O. Similarly, Surlekov and Rankov (1989) reported significantly higher chillies yield with the application of FYM along with 100:80:100 kg ha^{-1} NPK when compared to control. Inorganic nutrients enhanced fertilizer use efficiency and economy at lower application levels, while organic nutrients showed such effect at higher levels. Khan *et al.* (2012) also emphasized on weed management in vegetable by using organic approaches.

CONCLUSION

It was also concluded that 50% PWC combined with 50% of the recommended NPK produced higher yield and lower weed density. Thus, parthenium weed composting is an environment friendly management strategy of parthenium weed and a beneficial utilization option of the allelopathic effect of this noxious weed on one hand and is as a source of crop nutrition on the other.

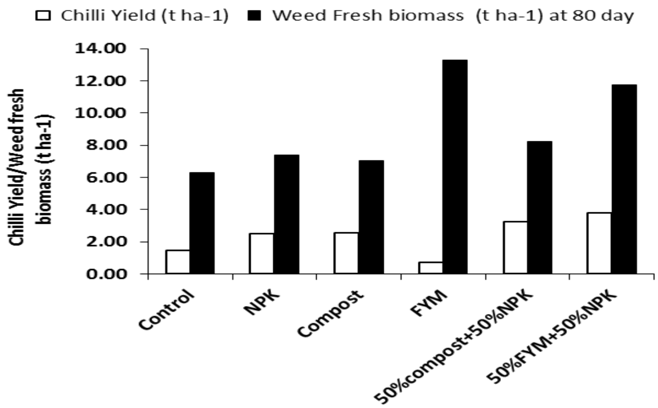

Figure 3. Effect of parthenium weed compost in comparisons with other nutrient sources on weed fresh biomass and chili yield

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