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INFLUENCE OF ORGANIC AND INORGANIC AMENDMENTS ON WEEDS DENSITY AND CHEMICAL COMPOSITION

Kawsar Ali[1], Muhammad Arif[1], Waheed Ullah[2], Abdullah[1], Wiqar Ahmad[3], M. Rabnawaz Khan[1], L.S. Ayeni[4], M. Amin[5] and Muhammad Jehangir[6]

ABSTRACT

Incorporation of biochar to agriculture field has got a primary factor in maintaining soil fertility and productivity particularly in nitrogen and organic matter limiting environments. Clear experimental evidence to support this view, however, is still lacking. Also effective weeds control at early stage is always first priority of maize growers. Taking in account the adverse effects of synthetic fertilizers, agriculture scientists are trying for shifting inorganic farming to organic one. In the current experiment the effect of organic amendments (biochar and FYM) were evaluated along with mineral N on weeds density and their nutrients uptake from soil. The experiment was conducted at New Developmental Farm of the University of Agriculture Peshawar Pakistan. The experiment consisted of three levels of biochar (0, 25 and 50 t ha^{-1}), two levels of FYM (5 and 10 t ha^{-1}) and two levels of mineral N (75 and 150 kg ha^{-1}) and a control treatment for comparison. The findings suggested that higher rate of BC (50 t ha^{-1}), FYM (10 t ha^{-1}) and N 150 kg ha^{-1} improved weeds density by 21%, 45% and 19%, respectively as compared to their lower application rate such as 25 t, 5 t and 75 kg N ha^{-1}, respectively. Application of N at 150 kg and 10 t FYM ha^{-1} increased weed dry weight by 45 and 29% respectively. Application of FYM @ 10 t ha^{-1} increased weeds N, P and K content by 37, 21 and 17% respectively over FYM @ 5 t ha^{-1}. Application of mineral N @ 150 kg ha^{-1} resulted in 29% increase in weeds N content as compared to 75 kg N ha^{-1}. Biochar application considerably increased weeds P and K content. Application of 50 t BC ha^{-1} increased weeds P and K content by 9 and 11% over 25 t BC application and by 21 and 27% over no BC treated plots. Overall, organic amendments and N fertilization increased weeds

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[1]Dept. of Agronomy, [2]Dept. of Water management, [3]Dept. of SES, [5]Dept. of Agri. Mechanization, [6]Dept. of Horticulture, The University of Agriculture, Peshawar Pakistan.
[4]Dept. of Agricultural Science, Adeyemi College of Education, Ondo, Ondo State, Nigeria
*Corresponding author's email: kawsar@aup.edu.pk

density, nutrients uptake and dry weight. Efficient weeds control strategies should be designed before organic manipulation of field.

Key words: Biochar, weeds, organic amendments and weeds chemical composition.

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INTRODUCTION

Effective weeds control is a major constraint in organic production. Among the major soil problems, the flora and fauna of weeds are considered the most important one. Besides adverse effect on crops, presence of weeds in field affects soil ecological process such as decomposition, mineralization and energy turnover. Nutrient competition is an important mechanism by which weeds affect the growth of crops. Adequate availability of essential nutrients needed for all crops but plants differ in the way they respond to nutrient availability mainly because of differences in their root structures or growth stage. Application of fertilizer to crop play important role in promoting weeds population in crop as weeds are always strong competitor of crops for available resources like nutrients, space, moisture and light (Ali *et al.*, 2013). Previous findings suggested that fertilized plots increased weeds density by three fold over control (Ali *et al.*, 2012). Researchers believe that application of organic manure are more superior for boosting crop yield and soil fertility over synthetic fertilizer (Arif *et al.*, 2012; Ali *et al.*, 2012; Yeboah *et al.*, 2009). This concept if further strengthen by Jones *et al.* (2009) who found that plants are able to utilize nitrogen in organic form as well. However, it was found that application of organic manure can increased weeds population (Arif *et al.*, 2013) as most of the time incorporation of organic manure such as (FYM and poultry manure) served as weeds seeds store bank (Baig *et al.*, 2001). The management of crop fertilization may be an important component of integrated weed management systems (Blackshaw *et al.*, 2005). Weed dynamics change according to different organic sources of nutrients. Manure is mainly used as a nutrient source and also in order to improve soil fertility (Baitilwake *et al.*, 2011; Ali *et al.*, 2012b). However, its use can be a source of weed infestation. Among the manures used, FYM has high N content and good weed control efficacy due to its phytotoxic character (Baig *et al.*, 2001). Haidar and Sidahmed (2006) have also reported that chicken manure was effective in reducing Orobanche ramosa growth and infestation early in the season in comparison with the control. Several factors affect maize growth and yield. One of the most important factors is weeds competition with maize crop for available resources (Arif *et al.*, 2007). It has been reported as one of the major causes of poor maize yields in cereal based cropping pattern of Pakistan (Ali *et al.*, 2011). This competition is most serious and drastically reduce maize yield at initial crop growth stage (Mitchell *et al.*, 2010). Nitrogen promote crop vegetative growth and increase yield (Ali *et al.*, 2012). However, under the adequate supply of essential nutrients and soil moisture, successful cultivation of maize depends largely on efficient weed control. Water and fertilizer use efficiency are the two most important inputs for obtaining high yields under irrigation and it is adversely affected by poor weed control (Tolessa and Friesen, 2001). The effect of organic (Biochar and FYM) and inorganic fertilizers are evaluated on weeds density, biomass and nutrients uptake. Biochar contains some important plant nutrients which significantly affect crop growth. Maize yield and nutrient uptake were significantly improved with increasing biochar application rate in combination with other commercial fertilizers. Yield characteristics and water use efficiency of maize was increased from 50 to 100% when biochar application rate was increased from 15 to 20 t ha^{-1} (Uzoma *et al.*, 2011). Nutrient uptake and crop growth rate was increased with higher biochar applications. Maize yield and yield components showed positive response when biochar was used as soil amendment because it improves the field-saturated hydraulic conductivity of the sandy soil, as a result net WUE also increased and more moisture and nutrients were available to the crop throughout the growing season (Steiner, *et al.*, 2007). The current experiment is designed with the aim to investigate the effect of integrated nutrients management on weeds growth and nutrients uptake.

MATERIAL AND METHODS

Site and soil

The experiment was conducted at the New Developmental Farm of the University of Agriculture, Peshawar located at 34.1°’21”N, 71°28’5”E. The soil of the experimental soil has alkaline nature. The soil is deficient in N and P but have adequate potassium content and have less than 1% organic matter content (Table-1). The site has a warm to hot, semi-arid, sub-tropical, continental climate with mean annual rainfall of 360 mm with a summer (May–September) mean maximum temperature of 40°C and mean minimum temperature of 25°C. Canal water is the major irrigation source.

Experimental design, treatments and fertilizer application

The experiment was conducted in RCB design. The experiment consists of three factors such as Biochar (BC) farmyard manure (FYM) and mineral nitrogen (N). Biochar was applied at three levels (0, 25 and 50 t ha^{-1}), FYM was applied at levels (5 and 10 t FYM ha-1) and two levels of nitrogen (75 and 150 kg ha^{-1}) were used in the experiment. All these level were adjusted in 12 treatments. A control treatment was included for comparison. All the treatments were having three replicates and total 39 experimental units were made. Maize variety "Azam" was sown on 25th June 2014. Biochar was applied to wheat crop only and its residual effect was studied on maize crop and soil fertility along with weeds population and chemical analysis. Farmyard manure was applied before sowing of maize while N was applied 10 and 35 days after sowing. Chemical analysis of biochar and FYM were performed before its application to soil (Table 2). Urea was used as source of nitrogen while DAP was used as source of Phosphorus. Phosphorus was applied at the rate of 90 kg ha^{-1} to all plots to insure crop and weeds have enough available P. Data were recorded on weeds density 30 and 60 and 90 days after sowing, weeds fresh and dry weight, weeds N content and weeds N-uptake at all the three intervals.

Weeds harvesting and tissue analysis

After the establishment of the experiment, weeds samples were collected 30, 60 and 90 days after sowing. Standard procedure was used for sample collection, density calculation and fresh weight measurement (Ali *et al.*, 2012). The collected plant samples were washed by distilled water and subjected to air drying for 48 hours. The air dried samples were dried at 80°C, for 24 hours in oven weighed and then ground. The dried plant tissues were ground into 0.25 mm size and transported to ILRI for N, P, and K analyses. The plant tissues were subjected to wet digestion. The N content of the plant tissue was determined by Kjeldahl procedure, whereas the P content was determined by calorimetrically according to Murphy and Riley (1962), and the plant tissue K content was determined by flame photometer.

RESULTS AND DISCUSSION

Response of weeds density and NPK content to biochar application

The experimental results indicated that biochar (BC) had non-significant effect on weeds density at 30 days after sowing (DAS). However, at 60 and 90 DAS, weeds population was significantly affected by BC application. At both stages higher weeds density was recorded in plots treated with 25 t BC ha^{-1} which was at par with no BC application of 50 t ha^{-1} while no BC plots resulted in lower weed density (Table-1). Regarding weeds dry weight, no significant change was found in weeds dry weight due to BC application at any growth stage (30, 60 or 90 DAS). However, increase in dry weight was noted as weeds growth duration was prolonged from 30 to 90 DAS (Table-2). No significant change in weeds N content was observed due to incorporation of BC (Table3). Interestingly, weeds phosphorus (P) content was significantly affected by BC application at all growth stages (30, 60, 90 DAS). Higher P content in weeds was recorded in 50 t BC ha^{-1} followed by 25 t BC ha^{-1} as compared to no BC application at any stage 30, 60 and 90 DAS. Similarly, biochar application did not significantly affected weeds potassium content (K) at 30 DAS however, significantly increased was noted in weeds K content at 60 and 90 DAS as BC application rate was increased from 0 to 50 t ha^{-1}. Higher K content in weeds were found collected from 50 t ha^{-1} BC followed by BC application of 25 t ha^{-1}. Possible explanation for increase in weeds density and NPK content in biochar amendments plots include the effect of biochar on soil physio-chemical properties like enhance water holding capacity, increased cation exchange capacity (CEC), and providing a medium for adsorption of plant nutrients and improved conditions for soil micro-organisms (Sohi et al 2009).Biochar efficiently adsorbs ammonia (NH_4) (Oya and Iu 2002 and Iyobe *et al.*, 2004) and acts as a binder for ammonia in soil, therefore having the potential to decrease ammonia volatilization from soil surfaces. These results are in accordance with Singh *et al.* (2010) who suggested that timely availability of N could be insured for higher corn productivity by combined use of mineral N and Organic manures .These results are also supported by Boateng *et al.* (2006) and Ali *et al.* (2011) who found that corn yield was 35% increased by integrated N management compared to sole mineral or organic fertilizer application.

Response of weeds density and NPK content to FYM application

Application of FYM significantly increased weeds density at 30, 60 and 90 DAS (Table-1). Application of FYM at higher rate (10 t ha^{-1}) encouraged weeds population and resulted in higher weeds density at all three stages as compared to its lower rate (5 t ha^{-1}). Moreover, weeds dry weight was significantly affected by FYM application and higher dry weight was recorded in plots treated with 10 t FYM ha^{-1} as compared to 5 t FYM (Table-2). Unlike BC, weeds N content was significantly affected by FYM application (Table-3). As FYM application rate increased from 5 to 10 t ha^{-1} weeds N content was increased from 0.71 to 0.87% at 30 DAY, 1.19 to 1.42% 60 DAS and from 1.21 to 1.49% 90 DAS. Furthermore, FYM application synergistically increased weeds P content at all three stages (Table-4). Incorporation of FYM at the rate of 10 t ha^{-1} was found more effective over 5 t FYM ha^{-1} for improving weeds P content at all three stages (30, 60 and 90 DAS).

The effect of FYM on weeds K content is presented in Table-5. Chemical analysis of the weeds biomass indicated that FYM application at higher rate (10 t FYM ha^{-1}) resulted in higher weeds K content over it lower rate (5 t FYM ha^{-1}) at all three cutting stages (30, 60 and 90 DAS). The superiority of farmyard manure in terms of enhancing weeds population could be explained from the fact that FYM contains indigenous seed bank and also essential nutrients required for rapid weeds growth. Similar results were reported by Ali *et al.* (2011) who found higher weeds density in FYM and N amended plots. Possible reason for higher weeds density in organic manure plots maybe the manures contain different weeds seeds and thus increased weed seed bank in field. Similar results were reported by Hammad *et al.* (2010) who stated that application of organic manures resulted in higher weeds biomass and weeds density. FYM increased the microbial activity that might in turn enhance the rate of decomposition of organic matter and nutrients were available to plants for growth. Results of previous studies indicated that use of organic sources as FYM produced equivalent or increased plant nutrients uptake and NPK content. (Alam and Shah, 2003;Khanum *et al.*, 2001).

Response of weeds density and NPK content to N-fertilization

The effect of fertilizer application on weeds density at 30, 60 and 90 days after sowing is presented in Table-1. N application significantly enhanced weeds density and weed dry weight at 60 and 90 DAS while no significant change was found both in weeds density and dry weight of weeds at 30 DAS. Weed density and weed dry weight was higher at 150 kg ha^{-1} than 75 kg ha^{-1} at 60 and 90 DAS . The effect of N fertilization on weeds N content is presented in Table-3. Application of N at the rate of 150 kg ha^{-1} positively increased weeds N content over 75 kg N ha^{-1} at 60 and 90 DAS. In contrast, no significant effect of N application on weeds P content was recorded (Table-4) but weeds K content (Table-5) was also significant**.** The increase in weeds density and weeds NPK content in N fertilized plots at higher rate might due to promoting ability of N on vegetative growth and encourages the formation of more leaves per plant. Our results are confirmed by the finding of Ali *et al.* (2011 and Ali *et al.* (2012) who investigated higher weeds density and biomass weight in N fertilized plots. Arif *et al.* (2014) are of the view that Increasing N rate resulted in increased weeds density in maize crop.

CONCLUSION

The findings suggested that weeds density was significantly enhanced by organic and inorganic amendments. Application of BC and FYM improved weeds density and NPK content. Likewise, higher dose of N increased weeds density, dry weight and N content. In order to reduce losses due to weeds, and competition for nutrients, effective weeds control strategies should be adopted along with organic amendments of crop fertilization for enhancing yield of maize crop.

Table-1. Biochar, FYM and N application effect on weeds density (m^{-2})

Biochar (t ha^{-1})	Weeds density (m^{-2})		
	30 DAS	60 DAS	90 DAS
0	25	35 b	75 b
25	29	47 a	95 a
50	27	43 a	91 a
L.S.D	ns	8.3	12.4
FYM (t ha^{-1})			
5	21	39	80
10	31	47	110
Significance Level	*	**	*
Nitrogen (kg ha^{-1})			
75	19	45	77
150	21	57	94
Significance Level	ns	*	*
Interactions			
BC x N	ns	ns	ns
BC x FYM	ns	ns	ns
N x FYM	ns	ns	ns
BC x N x FYM	ns	ns	ns

Means of the same category followed by different letters are significantly different from one another at 5% and 1% level of probability.
*, ** = Significant at 5 and 1% level of probability, respectively.
ns = non-significant; DAS = Days after sowing

Table-2. Biochar, FYM and N application effect on Weeds dry weight

Biochar (t ha^{-1})	Weeds dry weight (kg ha^{-1})		
	30 DAS	60 DAS	90 DAS
0	65	75	117
25	75	79	121
50	69	81	125
L.S.D	ns	Ns	Ns
FYM (t ha^{-1})			
5	63	75	102
10	79	98	130
Significance Level	*	*	*
Nitrogen (kg ha^{-1})			
75	55	72	101
150	78	87	118
Significance Level	ns	*	*
Interactions			
BC x N	ns	Ns	ns
BC x FYM	ns	Ns	ns
N x FYM	ns	Ns	ns

BC x N x FYM	ns	Ns	ns

Means of the same category followed by different letters are significantly different from one another at 5% level of probability.
*= Significant at 5, ns = non-significant; DAS = Days after sowing

Table-3. Biochar, FYM and N application effect on weeds N content

Biochar (t ha^{-1})	Weeds nitrogen content (%)		
	30 DAS	60 DAS	90 DAS
0	0.75	1.22	1.32
25	0.74	1.41	1.29
50	0.79	1.43	1.30
L.S.D	Ns	ns	Ns
FYM (t ha^{-1})			
5	0.71	1.19	1.21
10	0.87	1.42	1.49
Significance Level	*	*	*
Nitrogen (kg ha^{-1})			
75	0.65	1.13	1.27
150	0.83	1.28	1.37
Significance Level	Ns	*	*
Interactions			
BC x N	Ns	ns	Ns
BC x FYM	Ns	ns	Ns
N x FYM	Ns	ns	Ns
BC x N x FYM	ns	ns	Ns

Means of the same category followed by different letters are significantly different from one another at 5% level of probability.
*= Significant at 5% level of probability, ns = non-significant

Table-4. Biochar, FYM and N application effct on weeds P content

Biochar (t ha^{-1})	Weeds phosphorus content (%)		
	30 DAS	60 DAS	90 DAS
0	0.09	0.12	0.13
25	0.12	0.14	0.15
50	0.14	0.17	0.18
$LLsd_{0.05}$	ns	ns	ns
FYM (t ha^{-1})			
5	0.08	0.13	0.14
10	0.09	0.16	0.18
Significance	*	*	*
Nitrogen (kg ha^{-1})			
75	0.07	0.12	0.12
150	0.08	0.1	0.13
Significance	ns	*	*
Interactions			
BC x N	ns	ns	ns
BC x FYM	ns	ns	ns
N x FYM	ns	ns	ns
BC x N x FYM	ns	ns	ns

Means of the same category followed by different letters are significantly different from one another at 5% level of probability.
* = Significant at 5% level of probability, ns = non-significant

Table-5. Biochar, FYM and N application effect on weeds K content

Biochar (t ha^{-1})	weeds potash content (%)		
	30 DAS	60 DAS	90 DAS
0	1.5	1.6	1.8
25	1.4	1.8	2.1
50	1.6	1.9	2.4
L.S.D	ns	0.03	0.14
FYM (t ha^{-1})			
5	1.2	1.6	2.1
10	1.6	1.9	2.5
Significance	*	*	*
Nitrogen (kg ha^{-1})			
75	1.4	1.6	2.4
150	1.3	1.7	2.2
Significance	ns	*	*
Interactions			
BC x N	ns	ns	Ns
BC x FYM	ns	ns	Ns
N x FYM	ns	ns	Ns
BC x N x FYM	ns	ns	Ns

Means of the same category followed by different letters are significantly different from one another at 5% level of probability.
*=Significant at 5% level of probability, ns = non-significant

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