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Weed and Nutrient Management Practices on Weed Dynamics and Yield of Maize + Cowpea Intercropping System

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Abstract: ***A field experiment was conducted during two consecutive kharif season of 2015 and 2016 at Central Research Station of the College of Agriculture, OUAT- Bhubaneswar to study the influence of weed and nutrient management practices on weed dynamics and yields of maize + cowpea intercropping system. The field experiment was laid out in a split-plot design with three replications. There were altogether 16 treatment combinations with Main Plot (Nutrient management): F_1=RDF i.e. 120, 60, 60 kg/ha N, P_2O_5 and K_2O for 100 per cent maize +10, 20, 10 kg/ha N, P_2O_5 and K_2O for 50 per cent cowpea population., F_2= RDF+FYM 5 t/ha, F_3= RDF+ 0.2 Lime requirement (LR), F_4= RDF+FYM 5t/ha + Lime 0.2 LR and Sub-Plot (Weed management): W_1= Pendimethalin 0.75 kg/ha, W_2= Oxyfluorfen 0.03 kg/ha, W_3= Farmer practices at 20 DAS, W_4= Weedy check. Pre-emergence application of oxyfluorfen @ 0.03 kg/ha and combined application of RDF+ FYM+ lime significantly reduced the total weed density, weed dry weight and increase weed control efficiency at all the stages. The same treatments gave maize grain yield of 6.63 and 5.87 t/ha and cowpea green pod yield of 3.1, 3.0 t/ha. These treatments proved to be the best for effective weed-control and system productivity and gave the maximum maize equivalent yield of 9.80, 8.89 t/ha and hence increased the productivity of maize + cowpea intercropping system.***

Keywords: Cowpea, Maize equivalent yield, Nutrient management, Oxyfluorfen, Pendimethalin and Weed control efficiency.

1. Introduction

Weed, play a significant role in reducing the yield of crop and are potentially a major constraint on crop production if not controlled. They compete with crops for natural and applied resources besides being responsible for reducing quantity and quality of agricultural productivity.

2. Literature Survey

Maize is the world's third most cereal crop after wheat and rice. In India, it is grown over an area of 9.43 m ha with total production of 24.35 m tones with an average productivity of about 2.57 t/ha compared to the world average productivity of about 4.94 t/ha [1]. Maize, being a rainy season and widely spaced crop, gets infested with variety of weeds and subjected to heavy weed competition, which often inflicts huge losses ranging from 28 to 100 per cent [2]. Currently there are very few herbicide options available for weed control include pre-emergence application of atrazine, simazine, pendimethalin, alachlor. Most of these herbicides provide only a narrow spectrum weed control in maize [3]. Weed control approach involving intercropping, use of newly released herbicides with new modes of action and non-chemical method in maize + cowpea intercropping system is very important to provide effective and acceptable weed control for realizing high production.

Although, chemical fertilizers are playing a crucial role to meet the nutrient requirement of the crop, the continued application of chemical fertilizer leads to deterioration of soil health with reduced organic carbon and increased multi-nutrients deficiencies [4] which posing a greater threat to sustainable agriculture if used alone. In this endeavor proper blending of inorganic fertilizer and organic manure is important not only for increasing yield, but also for sustaining soil health. An application of inorganic fertilizers with organic manures helps in improving physico-chemical properties of the soil and improves the utilization of applied fertilizers resulting in higher yield and quality [5].

Keeping all these aspects in view, it was felt necessary to conduct the experiment entitled "Weed and nutrient management practices on weed dynamics and yields of maize + cowpea intercropping system".

3. Material and Methods

A field experiment was conducted during two consecutive *kharif* season of 2015 and 2016 at Central Research Station of the College of Agriculture, OUAT- Bhubaneswar. The soil of the experimental plot was loamy sand in texture, low in available nitrogen (134 kg/ha), high in available phosphorus (87.5 kg/ha) and low in available potassium (71.6 kg/ha), organic carbon 0.24% and pH (4.71), EC dsm^{-1} (046). The field experiment was laid out in a split-plot design with three replications. There were altogether 16 treatment combinations with Main Plot (Nutrient management): F_1=RDF i.e. 120, 60, 60 kg/ha N, P_2O_5 and K_2O for 100 per cent maize +10, 20, 10 kg/ha N, P_2O_5 and K_2O for 50 per cent cowpea population., F_2= RDF+FYM 5 t/ha, F_3= RDF+ 0.2 Lime requirement (LR), F_4= RDF+FYM 5t/ha + Lime 0.2 LR and Sub-Plot (Weed management): W_1= Pendimethalin 0.75 kg/ha, W_2= Oxyfluorfen 0.03 kg/ha, W_3= Farmer practices at 20 DAS, W_4= Weedy check. Tested varieties are Hybrid maize (PAC 751) and Cowpea (Kashi kanchan) was sown with spacing of 60×30 cm and 30×15cm, respectively on opening of shallow furrows of 5 cm deep. Sowing was performed on 25^{th} and 27^{th} of June 2015 and 2016, respectively. Urea, Single Super Phosphate and Potash was the Source of Nitrogen, Phosphorous and Potash respectively. As basal dose, one third dose of N, full dose of P and half dose of K was applied. The remaining two third of the nitrogen and half of potash was applied at knee high. The herbicides were applied as pre-emergence on next day after sowing using Knapsack sprayer fitted with flat fan nozzle by mixing 500 litres of water per ha. Hand weeding as per treatment was done at 20 DAS. Weedy check plots remained infested with native population of weed till harvest. The observations on weed density and there dry matter were taken randomly m^2 quadrate from net plot area from each treatments then oven dried for 48 hours at 700C. Weed control efficiency (WCE) was calculated on the basis of formula suggested by [6].

$$\mathrm{WCE} = \frac{\mathrm{DWC} - \mathrm{DWT}}{\mathrm{DWC}}$$

Where: WCE = Weed Control Efficiency, DWC = Dry weight of weed (control plot), DWT= Dry weight of weeds from treated plot.

The other management operations were done as per recommended package of practices.

4. Results and Discussion

Weed flora in the experimental field:
Major weed flora in the experimental field consisted of grasses viz. *Digitaria sanguinalis* (L.) Scop., *Echinochloa colonum* (L.) Link, *Cynodon daectylon* (L.) Pres. Sedges, *Cyperus rotundus* (L.) *Cyperus iria* (L.) *Cyperus diformis* and broad leaf weeds (BLW) *Ammania bacifera* (L.), *Eclipta prostrata* (L.), *Eclipta alba* (L.), *Commelina benghalensis* (L.).

Effect on weed:
In general, the density and dry weight of weeds were significantly reduced with the application of herbicides (Table 1). Significantly lower density and dry weight of weeds /m^2 and higher weed control efficiency were recorded with oxyfluorfen @ 0.03 kg/ha followed by farmer practices (20 DAS) at 30 DAS and pendimethalin @ 0.75 kg/ha at 60 DAS and harvest. This might be probably due to phytotoxic effect of chemicals on broad spectrum of weeds resulting in death of most of the weeds. The herbicides gave almost season-long control of weeds obviously due to their persistence in soil for a sufficiently long time. While under farmers' practices, it might be attributed to the reduced crop weed competition through hand weeding at 20 days. Application of oxyfluorfen @ 0.03 kg/ha was found effective than pendimethalin @ 0.75kg/ha. Similar results were also obtained by [7], [8].

Combined application of recommended NPK + FYM + lime gave the lowest weed density and dry weight at all the stages of crop growth. Highest weed control efficiency at 30, 60 DAS and harvest was recorded with application of oxyfluorfen @ 0.03 kg/ha (79.8, 79.0 and 11.0% respectively) followed by farmer practices at 20 DAS with the value of 66.8% at 30 DAS and pendimethalin @ 0.75 kg/ha at 60 DAS and harvest (41.3 and 13.71% respectively). Lower weed control efficiency was recorded under weedy check (Table 1). The higher weed control efficiency could be attributed to the lower weed population as well as dry matter accumulation of weeds in these treatments. Also higher WCE might be due to smothering effect of cowpea in maize +cowpea intercropping system. In case of weedy check it might be due to higher weed intensity and dry matter accumulation of weeds in these treatments. These results corroborate with the findings of [9].

Table 1: Total weed density, weed dry weight and weed control efficiency in maize + cowpea as influenced by different weed and nutrient management treatments (Pooled of 2 years)

Treatments	30 DAS			60 DAS			Harvest		
	Weed density (no/m^2)	Weed dry weight (g)	WEC (%)	Weed density (no/m2)	Weed dry weight (g)	WEC (%)	Weed density (no/m2)	Weed dry weight (g)	WEC (%)
Nutrient management									
F1	15.0 (254.0)	7.6 (66.2)	46.3	14.5 (226.3)	9.0 (91.6)	24.4	13.1 (180.6)	10.2 (106.0)	5.9
F2	14.9 (236.7)	7.3 (60.6)	50.9	13.2 (183.0)	8.4 (79.7)	34.2	12.1 (149.8)	9.6 (96.5)	14.3
F3	15.3 (261.3)	7.3 (63.4)	48.6	12.9 (172.3)	7.6 (68.4)	43.5	12.2 (164.6)	10.1 (102.7)	8.7
F4	13.4 (198.2)	6.8 (49.0)	60.3	12.3 (162.0)	7.5 (63.1)	47.9	12.2 (150.0)	9.5 (94.2)	16.3
SE m±	0.3	0.1		0.3	0.2		0.4	0.3	
CD(P=0.05)	0.9	0.2		0.9	0.8		NS	NS	
Weed management									
W1	13.7 (199.5)	6.9 (50.1)	59.4	12.0 (148.8)	8.1 (71.1)	41.3	11.5 (133.8)	9.9 (100.1)	11.1
W2	11.0 (127.7)	4.9 (25.0)	79.8	10.7 (123.5)	4.8 (25.4)	79.0	10.4 (113.9)	8.8 (81.6)	27.5
W3	12.7 (167.8)	6.4 (40.9)	66.8	13.4 (186.2)	8.8 (85.1)	29.8	12.7 (165.9)	10.2 (105.2)	6.6
W4	21.2 (455.2)	10.8 (123.3)	0.0	16.8 (285.2)	10.7 (121.1)	0.0	15.0 (231.4)	10.5 (112.6)	0.0
SE m±	0.2	0.1		0.3	0.2		0.2	0.2	
CD(P=0.05)	0.5	0.2		0.9	0.6		0.7	0.5	
Interaction									
SE m±	0.3	0.1		0.6	0.4		0.5	0.3	
CD(P=0.05)	1.0	0.4		1.9	1.3		1.4	1.0	

Transformed values[$\sqrt{(x+0.5)}$], Figures in the parentheses indicate original values, WEC= Weed control efficiency and DAS= Days after sowing.

Yield and yield attributes of crop

Significant increase in number of grain per cob, 100 - grain weight and grain yield of maize were observed due to different weed management practices (Table 2). Number of grain/cob (546) and 100 - grain weight (26.55g/plant) were significantly higher with application of pendimethalin @ 0.75 kg/ha which was at par with application of oxyfluorfen @ 0.03 kg/ha (521, grin/cob and 26.05 g/plant) followed by farmer practices (509, grin/cob and 25.35 g/plant). In general, the herbicides oxyfluorfen 0.03 kg/ha was found to be superior and recorded higher grain yield of 6.63 t/ha and maize equivalent yield of 9.80 t/ha followed by application of pendimethalin which was at par with farmer practices at 20 DAS, however the lowest grain yield was recorded in weedy check treatment with the value of 2.93 t/ha. Higher grain yield due to application of oxyfluorfen @ 0.03 kg/ha could be attributed to minimum crop-weed competition throughout the crop growth period, which was due to effective control of weeds and minimum dry weight of weeds, thus enabling the crop for maximum utilization of nutrients, moisture, light and space which had influence the growth and yield components which resulted in higher grain yield. Significantly highest number of pods/plant (30.05) and pods yield of cowpea (3.1 t/ha) was found in absence of crop-weed competition created due to application of pre-emergence application of oxyfluorfen @ 0.03 kg/ha followed by application of pendimethalin @ 0.03kg/ha (Table.2). The increase in number of pods per plant and pods yield under these treatments may be because of better management of weeds during early crop growth which resulted in higher dry matter accumulation, which resulted in greater translocation of photosynthates to the reproductive parts and reflected in superiority of pods per plant and ultimately higher pod yield. Our results confirm those of [10]

Nutrient management practices did not influenced the yield attributes of maize. The significant effect of nutrient management on maize grain yield and maize equivalent yield were recorded with the combination of recommended NPK + FYM along with lime (5.87 t/ha and 8.89 t/ha), however it was comparable with recommended NPK + FYM (5.49 t/h and 8.26 t/ha) and farmers' practices at 20 DAS (5.22 t/h) in case of grain yield (Table.2). Improvement in yield due to combined application of inorganic fertilizer and organic manure might be due to adequate quantities and balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favourable increase in yield attributes which ultimately led towards an increase in economic yield. Improved physiochemical properties of soil through the application of organic manure and control release of nutrients in the soil through their mineralization which might have facilitated better crop growth which enhanced the photosynthesis and translocation of carbohydrates to sink site might be the other possible reason for higher productivity. This finding confirms to those reported by [11]. Number of pods/plant and green pod yield of cowpea were also influenced significantly due to nutrient management practices (Table 2). The significantly highest number of pods/plant (28.05) and green pod yield (3.0 t/ha) were recorded with the application of recommended NPK+ FYM+ lime followed by application of RDF+ FYM (26.20 pods/plant and 2.7 t/ha). More number of pods/plant and the highest green pod yield might be mainly due to more survival of flower under high supply of photosynthates with the application of RDF + FYM + lime due to better nitrogen and phosphorus availability, better translocation within plants and favourable sink source ratio of photosynthates. Under this treatment also greater root extension under phosphorus application might have helped in greater uptake of nutrients which ultimately improved the yield attributing characters. [12] also found the highest maize grain yield, fresh pod yield of cowpea and the maximum maize equivalent yield under recommended NPK+FYM+ lime in maize+ cowpea (2:2).

Table 2: Effects of weed and nutrient management on yield attributes and yield of maize + cowpea intercropping system (Pooled of 2 years)

Treatments	Cowpea		Maize			
	Cowpea pods/plant	Green pod yield (t/ha)	No of grain/cob	100-grain weight (g)	Grain yield (t/ha)	MEY (t/ha)
Nutrient management						
F1	19.70	2.26	482	24.65	4.42	6.72
F2	26.20	2.72	509	25.10	5.49	8.26
F3	24.25	2.53	497	25.00	5.22	7.80
F4	28.05	2.96	534	25.80	5.87	8.89
SE m±	0.38	0.08	19	0.63	0.25	0.29
CD(P=0.05)	1.31	0.27	NS	NS	0.87	0.99
Weed management						
W1	27.85	2.90	546	26.55	5.97	8.92
W2	30.05	3.11	521	26.05	6.63	9.80
W3	25.15	2.83	509	25.35	5.48	8.36
W4	15.15	1.6	446	22.60	2.93	4.58
SE m±	0.71	0.18	20	0.53	0.20	0.26
CD(P=0.05)	2.08	0.53	59	1.56	0.58	0.77
Interaction						
SE m±	1.43	0.36	40	1.07	0.40	0.53
CD(P=0.05)	4.16	NS	117	3.12	NS	NS

Price: Maize grain Rs. 9800 t^{-1} and cowpea green pod Rs. 10000 t^{-1}

F_1= recommended dose of fertilizer (RDF), **F_2=** RDF+FYM 5 t/ha, **F_3=** RDF+ 0.2 Lime requirement (LR), **F_4=** RDF+FYM 5 t/ha + Lime 0.2 LR, **W_1=** Pendimethalin @ 0.75 kg/ha, **W_2=** Oxyfluorfen @ 0.03 kg/ha, **W_3=** Farmer practices at 20 DAS, **W_4=** Weedy check and MEY= maize equivalent yield.

Based on the above results and discussion, it can be concluded that pre-emergence application of oxyfluorfen @ 0.03 kg/ha and combined application of recommended dose of inorganic fertilizer (120-60-60 kg N, P_2O_5 and K_2O ha^{-1} for 100 per cent maize +10-20-10 kg N, P^2O5 and K_2O ha^{-1} for 50 per cent cowpea population) + FYM @ 5 t/ha + Lime @ 0.2 LR (480 kg/ha) can be followed for efficient weed-control and higher productivity of maize + cowpea under intercropping system.

5. Future Scope

Studies on weed control approach involving intercropping, use of newly released herbicides with new modes of action and non-chemical method in maize + cowpea intercropping system are needed to provide effective and acceptable weed control for realizing high production. Also more studies on integrated nutrient management involving the combed use of inorganic fertilizer and organic manure that can helps in improving physico-chemical properties of soil can be a possible way to avoid the consequences of continued application of chemical fertilizer, which posing a greater threat to sustainable agriculture.

References

[1] Anonymous: "Area, production and yield of cotton in India (major states)". Technical Report, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, New Delhi, p. 90, 2015.
[2] K. Birendra, K. Ranvier, K. Suman and H. Mizzanul, "Integrated weed management studies on weed flora and yield in kharif maize," Trends in biosci, 6 (2), pp. 161-164, 2013.
[3] V.J. Patel, P.N. Upadhyay, J.B. Patel and M.I. Meisuriya, "Effect of Herbicide mixtures on weeds in kharif maize (Zea Mays L.) under Middle Gujarat conditions," Indian J. Weed Sci, 38 (1&2), pp. 54-57, 2006.
[4] A. Swarup, "Lessons from long term fertilizer experiment in improving fertilizer use efficiency and crop yields," Fert. News, 47 (2**),** pp. 59-66, 71-73, 2002.
[5] B. A. Alabadan, P. A. Adeoye, and E. A. Folorunso, "Effects of different poultry wastes on physical, chemical and biological properties of soil," Caspian J. Environ. Sci., (7), pp. 31-35, 2009.
[6] V.S. Mani, M.L. Maha, K.C. Gautam, and Bhawan, "Weed killing chemicals in potato cultivation," Indian Farming, (23) pp. 17-19, 1973.
[7] S. Nadiger, R. Babu, and B.N. Aravinda kumar, "Bioefficacy of pre emergence herbicides on weed management in maize," Karnataka J. Agric. Sci., 26 (1), pp. 17-19, 2013.
[8] O. Sunday, and E.U. Udensi, "Evaluation of pre-emergence herbicides for weed control in cowpea (*Vigna unguiculata* (L.) Walp.) In a forest - savanna transition zone," American Journal of Experimental Agriculture, 3 (4), pp. 767-779, 2013.
[9] L.S. Deshmukh, A.S. jadhav, R.S. jathure, S.K. raskar, **"**Effect of nutrient and weed management on weed growth and productivity of *kharif* maize under rainfed condition," Karnataka J. Agric. Sci, 22 (4), pp. 889-891, 2009.
[10] D.C. Hanumanthappa, R. Mudalagiriyappa, G.N.V. Kumar, and K. Padmanabha, "Effect of weed management practices on growth and yield of cowpea (Vigna unguiculata L.) under rain fed conditions," Crop Research., 44 (1&2), pp. 55-58 2012.
[11] R.N. Katkar, B.A. Sonune and P.R. Kadu, "Long term effect of fertilization in soil chemical and biological characteristics and productivity under sorghum (Sorghum bicolour) - Wheat (Triticum aestivum) system in vertisol," Indian J. Agricultural Sciences, 81 (8), 734-739, 2011.
[12] E. Barik, B. Behera, S.N. Jena, M.R. Satapathy, and P.K. Roul, "Impact of planting pattern and nutrient management strategy on productivity and comparative economics of maize (*Zea mays* L.) + cowpea (*Vigna unguiculata* L. Walp.) intercropping under rainfed condition," Journal of Crop and Weed, 12 (3), pp. 79-82 2016.

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