

Effect of weed control and nitrogen application rates on weed infestation and productivity in maize-cowpea intercropping system

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ABSTRACT

A field experiment was conducted during 2002-03 and 2003-04 at Jabalpur to study the effect of three intercropping systems viz., maize (*Zea mays* L.) sole, maize + cowpea [*Vigna unguiculata* (L.)] for grain and maize + cowpea for fodder, two treatments of weed control viz., pendimethalin 1.0 kg/ha + 1 hand weeding at 30 DAS and weedy check, and three levels of nitrogen viz. 0, 50 and 100 kg N/ha on weed infestation and crop productivity. The total weed population at 60 DAS was significantly reduced by 36 and 32% under intercropping combinations of maize + cowpea (grain) and maize + cowpea (fodder), respectively as compared to sole crop of maize. The maize grain yield was at par (2969 kg/ha) in sole maize and maize + cowpea (grain). However, it was significantly reduced to 2225 kg/ha under maize + cowpea (fodder). The maize equivalent yield was higher under maize + cowpea (grain) treatment. The maize grain yield was significantly reduced under weedy check (2140 kg/ha). Increasing levels of N significantly increased the maize grain and maize equivalent yields. The uptake of N by weeds was significantly reduced under maize + cowpea intercropping combinations. The highest net monetary returns of Rs14547/ha and B: C ratio of 1.54 were obtained from maize + cowpea (grain) treatment.

Key words : Cowpea, Intercropping, Maize, Nitrogen, Residual effect, Weed management, Yield

Maize (*Zea mays* L.) is an important food crop in India. The crop grown in *kharif* season encounters abundant growth of wide range of weeds causing significant yield reduction which may vary depending upon the weed flora composition, their intensity and the duration of crop-weed association. Sharma *et al.* (2000) reported yield losses in maize due to weeds in the range of 32 to 42%. Whereas, Pandey *et al.* (2001) recorded reduction in the grain yield as high as 84.3% under season long weed competition in maize. No single method of weed control can be effective, hence integration of cultural and chemical methods is required to obtain desired weed control. The wide inter row space in maize crop permits growing of short duration intercrops especially of leguminous nature for weed suppression by smothering effect. Their role is likely to be more pronounced when integrated with herbicides and fertilizer nitrogen management. Pendi-methalin has been considered as a selective herbicide for weed control in maize and legume associations. Fertilizer nitrogen management plays a significant role in weed management; often the benefits derived go in favour of the crop and not the weed. Integration of intercrop, herbicide and nitrogen management may offer a better weed control strategy in maize crop. Therefore, a field study was undertaken in

maize to assess the effect of cowpea as intercrop, weed control and nitrogen levels on the weeds and crop productivity. The residual effects of treatments applied in maize were also studied on weeds in succeeding wheat crop.

MATERIALS AND METHODS

A field experiment was conducted for two consecutive years during 2002-03 and 2003-04 at National Research Centre for Weed Science, Jabalpur. The soil of the experimental site was clay loam (Typic Chromusterts), low in available N (218 kg/ha), medium in available P (16.0 kg/ha) and high in available K (415 kg/ha) with pH of 6.9 and EC 0.28 dS/m. The experiment was laid out in a split-split plot design comprising three levels of intercropping systems (maize sole, maize + cowpea (grain) and maize + cowpea (fodder) in the main plots, two levels of weed control (pendimethalin 1.0 kg/ha + 1 hand weeding at 30 days after sowing (DAS) and weedy check) in sub-plots, and three levels of N (0, 50 and 100 kg N/ha) in sub-sub plots. The treatments were replicated thrice. Maize cv 'Ganga 5' was sown in uniform rows of 60 cm, at a plant to plant distance of 30 cm, and between two rows of maize one row of cowpea cv 'UPC 5286' was sown under

1:1 ratio as per treatments. Maize and cowpea crops were sown in the first week of July during both the years. The full dose of P₂O₅ was applied as basal along with required amount of nitrogen as per treatment in two splits (half basal and remaining half 30 DAS) were applied to the maize crop. The maize crop was harvested in the first week of October during both the years. The fodder cowpea was harvested at 50 DAS. Weed population and dry weight in maize were recorded at 60 DAS. Residual effect of treatments given to maize was also studied on weeds and yield of wheat cv 'Sujata'. Irrespective of treatments, the wheat crop was given one hand weeding at 30 DAS after recording data on weeds. Weed count and dry weight were recorded from quadrates of 0.25 m² randomly selected at four places in each plot. Weed data were subjected to square-root transformation ($\sqrt{X+0.05}$) before statistical analysis. The maize equivalent yield and net returns were calculated on the prevailing market prices of the produce.

RESULTS AND DISCUSSION

Effect on weeds

The major weed flora observed in the experimental field comprised of *Echinochloa colona* (26%) among grasses, *Phyllanthus niruri* (44%) and *Commelina communis* (6%) among broad leaf weeds. The other weeds infesting the experimental field in relatively less numbers were *Cyperus iria*, *Cynodon dactylon*, *Ageratum*

conyzoides, *Oldenlandia corymbosa*, *Eclipta alba* and *Physalis minima*.

The total weed population at 60 DAS was significantly reduced by 36 and 32% under intercropping combinations of maize + cowpea (grain) and maize + cowpea (fodder), respectively as compared to sole crop of maize (Table 1). Beneficial effects of intercropping legumes in maize on weed control have been reported by Kumar and Thakur (2005). The density of *E. colona*, *P. niruri* and *C. communis* reduced significantly under intercropping treatments in comparison to sole maize. Similarly the total dry weight of weeds at harvest was found to be significantly lower under the maize + cowpea (grain) treatment, than that observed under sole maize and maize + cowpea (fodder) treatments. The inclusion of cowpea as intercrop in between maize crop rows covered the inter-row spaces quickly thus smothering the emergence of or emerged weeds. Selvakumar and Sundari (2006) have also reported reduction in density and dry weight of weeds by maize + cowpea intercropping system (Table 1).

Among the weed control treatments, application of pendimethalin 1.0 kg/ha along with one hand weeding at 30 DAS significantly reduced the density of weeds than weedy check.

Application of nitrogen at 50 and 100 kg/ha to maize crop resulted in significant reduction in total weed population at 60 DAS as compared to the treatment where nitrogen was not applied. Application of nitrogen would

Table 1. Effect of weed control and N application in maize-cowpea on weed density and biomass (mean data of 2 years)

Treatment	Weed density ((no./m ²))				Total weed dry weight (g/m ²)	N uptake (kg/ha)
	<i>E.c.</i>	<i>P.n.</i>	<i>C.c.</i>	Total		
Intercropping system						
Sole maize	5.3 (27.9)	7.5 (56.1)	3.5 (11.7)	10.4(107.5)	6.0(35.4)	9.8
Maize+ cowpea (G)	3.6 (12.9)	6.1 (37.2)	2.9 (8.1)	8.3(68.4)	4.8(22.5)	6.3
Maize + cowpea (F)	4.1 (16.8)	6.4 (40.6)	3.5 (11.7)	8.6(73.5)	5.3(27.8)	7.9
LSD (P=0.05)	0.5	0.6	NS	0.6	0.5	1.8
Weed control						
Pendimethalin 1.0 kg/ha + 1 hand weeding 30 DAS	1.7 (2.4)	4.5 (20.4)	2.0 (3.6)	5.5(29.7)	1.7(2.4)	2.2
Weedy check	6.0 (36.0)	8.3 (68.7)	2.7 (7.2)	12.8(163.2)	7.6(57.0)	14.3
LSD (P=0.05)	0.3	0.7	0.5	1.0	0.4	1.3
Nitrogen (kg/ha)						
0	4.3 (17.7)	7.0 (49.2)	2.9 (8.1)	9.6(92.0)	5.7(32.0)	7.7
50	4.6 (20.7)	6.3 (40.3)	3.5 (11.7)	8.9(78.7)	5.2(26.5)	8.3
100	4.4 (18.9)	6.4 (40.8)	3.3 (10.7)	8.8(76.9)	5.4(28.4)	8.8
LSD (P=0.05)	NS	NS	NS	0.7	0.4	0.9

Figures shown in parentheses indicate original values; G- Grain ; F- Fodder, *E.c.*- *Echinochloa colona*, *P. n.*- *Phyllanthus niruri*, *C.c.*- *Commelina communis*

have favoured the early growth and vigour of maize crop giving it a competitive edge over weeds.

Crop yield and yield attributes

Different intercropping systems could not influence the maize plant height, cobs/plant, grains/cob and test weight (Table 2). Whereas, pendimethalin 1.0 kg/ha + 1 hand weeding significantly increased the plant height, cobs/plant, grains/cob and test weight in maize as compared to weedy check. The growth and yield attributes of maize crop suffered due to severe weed competition in weedy check. Among the N doses tested, N100 kg/ha significantly increased the plant height and cobs/plant as compared to N0 and N50 kg/ha, however, the grains/cob and test weight remained at par with N50 and N100 but N0 resulted in significantly lower values of yield attributes.

The maize grain yield was equal (2969 kg/ha) under the treatments of sole maize and maize + cowpea (grain), however, it was significantly reduced to 2225 kg/ha under maize + cowpea (fodder). The reasons could be that weeds were smothered up to harvest of maize under maize + cowpea (grain) treatment, whereas later flushes of weeds started offering competition to maize under maize + cowpea (fodder) treatment after harvest of cowpea as fodder. An additional yield of 610 kg cowpea grain and 10398 kg cowpea fodder/ha could also be obtained from the intercropping treatments (Table 2). The maize equivalent yield was more under maize + cowpea (grain) treatment. Similar findings have been reported by Chalka and Nepalia (2005) and Selvakumar and Sundari (2006). The maize grain yield was significantly reduced under weedy check (2140 kg/ha) in comparison to application of pendimethalin 1.0 kg/ha followed by one hand weeding at 30 DAS (2811 kg/ha). Increasing levels of nitrogen significantly increased the maize grain and maize equivalent yields. Balwinder and Walia (2003) while studying the effect of N on weeds and maize also reported increase in maize yield with increase in N levels. Adding N fertilizer also improved most yield parameters in maize.

N uptake by weeds

The uptake of nitrogen by weeds was significantly reduced under intercropping combinations as compared to that recorded in sole crop of maize (Table 1). Chalka and Nepalia (2006) had also reported significant reduction

in N uptake by weeds under maize + cowpea intercropping system compared to that under sole maize. The weeds in weedy check treatment inflicted a loss of 14.3 kg N/ha, whereas the N uptake was least (2.2 kg/ha) under the treatment of pendimethalin 1.0 kg/ha + 1 hand weeding. Similar findings on N uptake by weeds were reported by Sinha *et al.* (2005). Among the N doses applied, the highest N uptake by weeds was recorded under N100 kg/ha. The difference in N uptake by weeds was ascribed to the differences recorded in dry weight of weeds at harvest.

Economics

The highest net monetary returns of Rs14547/ha was obtained from the intercropping treatment of maize + cowpea (grain) owing to the highest maize equivalent yield (Table 2). The net return was higher under the weed control treatment of pendimethalin 1.0 kg/ha + 1 hand weeding by 54% as compared to weedy check. Among different doses of N, the highest net return (Rs 15743/ha) was obtained from N100 kg/ha. Among the intercropping systems the highest B: C ratio of 1.54 was obtained from the treatment maize + cowpea (grain). B: C ratio of 1.38 was obtained with pendimethalin 1.0 kg/ha + 1 hand weeding as compared to 1.14 recorded under weedy check. Higher weed competition in weedy check resulted in lower maize equivalent yield which significantly lowered the net returns and B: C ratio (Table 2). Similar results have been reported by Chalka and Nepalia (2005).

Residual effect on wheat

The residual effect of treatments applied to maize crop was studied on succeeding crop of wheat. None of the treatments could exert any significant residual effect on density and dry weight of weeds recorded at 30 DAS in wheat crop. The grain and straw yields under different treatments were also statistically at par. However, an increase of 14-18 % in grain yield of wheat due to preceding treatment combination of intercropping cowpea in maize was encouraging.

It may be concluded that intercropping of cowpea for grain purpose along with application of pendimethalin 1.0 kg/ha followed by one hand weeding at 30 DAS and N application at 50 kg/ha in maize could result in lower weed infestation, higher crop productivity and more economic returns.

Table 2. Effect of intercrop, weed control and nitrogen on yield attributes, yield and net returns in maize (mean data of 2 years)

Treatment	Plant height (cm)	Cobs/ plant	Grains/ cob	Test weight (g)	Yield (kg/ha)		Maize – equivalent yield (kg/ha)	Cost of cultivation /ha (Rs)	Net returns /ha (Rs)	B: C ratio
					Maize	Inter crop				
<i>Intercropping system</i>										
Sole maize	175	1.17	349	200	2969		2969	7730	9787	1.26
Maize+ cowpea (G)	171	1.14	359	196	2966	610	4064	9430	14547	1.54
Maize + cowpea (F)	171	1.06	326	193	2225	10398	3265	9288	9894	1.10
LSD (P=0.05)	NS	NS	NS	NS	490		610	-	1880	0.24
<i>Weed control</i>										
Pendimethalin 1.0 kg/ha + 1 hand weeding 30 DAS	179	1.20	347	211	2811		3903	9880	13647	1.38
Weedy check	170	1.00	303	188	2140		2885	7752	8832	1.14
LSD (P=0.05)	7	0.16	33	13	240		540	-	2105	0.22
<i>Nitrogen (kg/ha)</i>										
0	159	1.06	313	178	1974		3182	8304	10469	1.26
50	179	1.14	358	197	2733		3801	8746	13585	1.55
100	188	1.17	363	199	3350		4279	9396	15743	1.68
LSD (P=0.05)	8	0.10	34	14	370		415	-	1840	0.22

G- Grain ; F- Fodder ; Sale price (Rs/kg): Maize grain 5.00, maize fodder 0.50, cowpea grain 9.00, cowpea green fodder 0.50

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