

Effect of weed-management practices on performance of prominent wet-season crops

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Received: September 2000

ABSTRACT

A field experiment was conducted during the wet season of 1995–96 to study weed dynamics and evolve a suitable weed-management practice on performance of some prominent wet-season crops of Chotanagpur Plateau region. Of all the crops, groundnut (*Arachis hypogaea* L.) registered maximum rice (*Oryza sativa* L.) equivalent (54.9 q/ha), net returns (Rs 8,504/ha) and benefit : cost ratio (1.34). Among the other crops, only finger millet [*Eleusine coracana* (L.) Gaertn] and soybean [*Glycine max* (L.) Merr.], being statistically at par, gave ratios more than 1. Similarly, among weed-control measures, recommended seed rate + hand-weeding caused the maximum equivalent (42.86 q/ha) and net returns (Rs 6,391/ha) but when the ratio was calculated the treatment (1.14) was found at par with 25% higher seed rate (1.08). Among the other measures, only recommended seed rate + herbicide (1.06) gave ratio 1 and was found comparable with 25% higher seed rate.

Key words : Herbicide, Rice equivalent, N uptake, Wet-season crops

Groundnut, soybean, finger millet, upland rice and urdbean are some major rainy-season crops in Chotanagpur plateau region. These crops occupy more than 80% of total cultivable land, but their production in the existing agro-climatic condition is very low. Among many factors responsible for low production, weeds occupy a dominant position. An experiment was undertaken with 5 prominent wet-season crops of the region and 5 weed-control measures including chemicals as well as cultural to select most suitable crop and weed-control measures to raise the

productivity and profitability of farmers of the region.

MATERIALS AND METHODS

An experiment was conducted to study the effect of weed-management practices on performance of some major wet-season crops during 1995–96 at Kanke, Ranchi. The soil was sandy-clay loam of low fertility status, having organic carbon 0.25% and available N, P_2O_5 and K_2O 184.9 and 127 kg/ha, respectively, with pH 6.4. The experiment was laid out in split-plot design with crops in main plot and

weed-control treatments in subplots (Tables 1 and 2) with 3 replications. Finger millet 'A 404' and upland rice 'Birsā Dhan 101', groundnut 'AK 12-24' and urdbean 'T 9' and soybean 'Bragg' were fertilized with 40:30:20; 25:50:25 and 20:60:40 N : P : K kg/ha respectively. Entire dose of N, P₂O₅ and K₂O was applied basal in soybean, groundnut and urdbean, while in finger millet and upland rice N was applied in 2 equal splits, half N basal and the remaining half N at 25 days after sowing. Crop-wise herbicides used were benthocarb, pendimethalin, butachlor and fluchloralin for finger millet, soybean and groundnut, upland rice and urdbean respectively. Recommended seed rate used were 10, 80,

20 and 100 kg/ha for finger millet, soybean and groundnut, urdbean and upland rice respectively. The crops were sown on 5 July and harvested in October except groundnut which was harvested on 3 and 5 November 1995 and 1996 respectively. The total rainfall in 1995 was 1,498.2 mm and in 1996 was 1,169.3 mm.

RESULTS AND DISCUSSION

Weed flora

The weed flora of the experimental site were dominated by *Echinochloa crus-galli* (L.) Link among grasses, *Fimbristylis miliacea* L. among sedges, *Commelina benghalensis* L. and *Ageratum conyzoides* L. among the broad-leaved weeds.

Table 1. Effect of crops and weed-control measures on population and dry weight of weeds, nutrient uptake by weeds and N uptake by plants (pooled data of 2 years)

Treatment	Weeds/ m ² at 60 DAS	Weed dry weight at 60 DAS (gm ²)	Weed index (%)	Nutrient uptake by weeds at maturity (kg/ha)			N uptake by plants (kg/ha)
				N	P	K	
<i>Crop</i>							
Finger millet	184.0	99.3	33.8	21.6	2.7	28.1	55.5
Soybean	176.2	94.8	20.7	19.2	2.6	26.5	115.2
Groundnut	186.5	95.3		17.2	2.2	26.4	107.3
Urdbean	142.9	81.6	42.7	17.2	1.8	26.0	72.3
Upland rice	207.0	110.1	60.5	21.8	2.8	29.8	55.1
CD (P=0.05)	10.5	5.4		0.4	0.3	1.4	8.8
<i>Weed control</i>							
Recommended seed rate	199.1	110.0	18.0	22.0	2.8	31.9	66.0
25% higher than RSR	187.8	97.9	11.5	21.3	2.7	29.5	77.1
50% higher than RSR	184.1	93.0	26.5	18.9	2.2	25.6	80.7
RSR + HW (20 DAS)	167.4	87.4		16.3	1.7	22.0	108.3
RSR + crop wise suitable herbicide	167.6	94.9	9.7	18.4	2.6	28.2	94.4
CD (P=0.05)	10.3	4.3		0.5	0.3	1.2	13.2

DAS, Days after sowing; RSR, recommended seed rate

Weed density

Of all the crops, the minimum weed density was recorded in urdbean - the extent of suppression of biomass for upland rice was 31%. It was followed in increasing order by that in soybean. Finger millet and groundnut were found as much infested with weeds as soybean. However, the maximum weed infestation was recorded in upland rice. Among the measures, recommended seed rate + hand-weeding or + herbicides being statistically at par, caused at most reduction in weed density. The extent of suppression of weed density under the treatments could be as high as 18.9%. The treatments were followed in increasing order by 25% higher seed rates were found equally effective.

Weeds biomass

Irrespective of crops, weed biomass remained the same as that of weed density. However, in decreasing the biomass the measures showed differential trend. Recommended seed rate + hand-weeding caused the maximum biomass. Here the extent of suppression of biomass compared to recommended seed rate was 63.2%. It was followed in increasing order by 50 and 25% higher seed rate. With respect to biomass reduction recommended seed rate + herbicide and 50% higher seed rate were found comparable. Of all the measures, most biomass was noted in case of recommended seed rate.

Weed index

Groundnut displayed minimum weed-index value. It was followed in increasing order by soybean, finger millet, urdbean

and upland rice. However, among the treatments, recommended seed rate + hand-weeding registered the lowest index value, followed in increasing order by recommended seed rate + herbicide, 25% higher seed rate and recommended seed rate. Of all measures, 50% higher seed rate showed the maximum index value.

Nutrient uptake by weed

Weeds associated with groundnut and urdbean took up least and equal quantity of N. The extent of N uptake by weeds under the crops compared with that with upland rice was 21.1%. It was followed in increasing order by that with soybean and finger millet. Weeds with upland rice and finger millet took up equal quantity of N. However, of all the measures recommended seed rate + hand-weeding caused minimum uptake of N by weeds, uptake being 25.9% compared to recommended seed rate. It was followed in increasing order by that with recommended seed rate + herbicides, 50 and 25% higher seed rate. However, among the measures, weeds in case of recommended seed rate took up maximum quantity of N.

The P uptake by weeds associated with various crops were found in increasing order of urdbean, groundnut and soybean. The extent of uptake under the crops compared with upland rice was 35.7, 21.4 and 7.1% respectively. Weeds in finger millet and upland rice took up as much quantity of P as that in soybean. However among the treatments, recommended seed rate + hand-weeding registered the lowest value of P uptake, being 39.3% compared with recommended seed rate. The treatment

Table 2. Effect of crops and weed-control measures on N uptake by crops, rice grain equivalent net return and benefit : cost ratio on crop

Treatment	Rice-grain equivalent (q/ha)			Net returns (Rs/ha)			Benefit : cost ratio		
	1995	1996	Pooled	1995	1996	Pooled	1995	1996	Pooled
Finger millet	33.77 (25.62)	37.05 (29.64)	34.41 (27.63)	4,062	4,779	4,420	0.97	1.15	1.06
Soybean	40.01 (16.64)	45.05 (20.28)	42.53 (18.46)	5,313	6,408	5,860	0.94	1.11	1.02
Groundnut	50.26 (13.38)	59.54 (15.94)	54.90 (14.66)	7,814	9,194	8,504	1.23	1.45	1.34
Urdbean	29.22 (8.16)	33.60 (9.60)	31.41 (8.88)	2,706	3,040	2,873	0.55	0.65	0.60
Upland rice	19.90 (19.90)	23.42 (23.42)	24.29 (21.66)	3,891	4,578	4,232	0.86	1.02	0.94
CD (P=0.05)	2.52	2.89	1.76	357	340	226	0.08 [*]	0.10	0.06
<i>Weed control</i>									
Recommended seed rate	32.08 (16.07)	38.12 (18.90)	37.73 (17.48)	4,619	5,435	5,027	0.94	1.0	0.97
25% higher than RSR	34.89 (13.97)	40.80 (20.54)	37.88 (17.25)	5,088	5,987	5,537	1.00	1.16	1.08
50% higher than RSR	29.26 (14.75)	33.65 (17.09)	31.45 (15.92)	3,300	3,804	3,552	0.61	0.73	0.67
RSR + HW (20 DAS)	39.41 (19.59)	46.21 (22.52)	42.86 (21.05)	5,765	7,018	6,391	1.05	1.23	1.14
RSR + crop-wise suitable herbicide	35.51 (16.41)	39.79 (96.57)	37.65 (56.49)	5,014	5,755	5,384	0.97	1.15	1.06
CD (P=0.05)	3.29	3.49	2.39	505	456	340	0.09	0.11	0.07

Original crop-wise grain yield in parentheses; rice-grain equivalent calculated on the basis of prevailing market price

was followed in increasing order by that with 50% higher seed rate and recommended seed rate + herbicide, weeds in recommended seed rate + herbicide, 25% higher seed rate or recommended seed rate took up similar quantity of P.

Like N and P, weeds with urdbean consumed least quantity of K, followed in increasing order by that with finger millet. The extent of uptake by weeds in urdbean compared to that with upland rice was 12.7%. Weeds with groundnut and soybean and similarly that with upland rice took up as much K as that with urdbean and finger millet respectively. Among the weed-control treatments, the uptake was found in increasing order of recommended seed rate + hand-weeding. (The extent of uptake compared to that with recommended seed rate being 31.0%), 50% higher seed rate, recommended seed rate + herbicide and recommended seed rate. The uptake due to recommended seed rate + herbicide and 25% higher seed rate was found statistically at par.

N uptake by plants

Of all the crops, soybean registered the maximum uptake of N, followed in decreasing order by urdbean and finger millet. The N uptake by groundnut and similarly by upland rice was found comparable with that by soybean and finger millet respectively.

Soybean and groundnut took up 109.1 and 94.7% higher N than upland rice. Among the measures, recommended seed rate + hand-weeding caused maximum uptake of N, followed in decreasing order

by recommended seed rate + herbicide, 50% higher seed rate and recommended seed rate. As compared to recommended seed rate, recommended seed rate + hand-weeding and recommended seed rate + herbicide caused 64.1 and 43.0% higher uptake of N in plants. However, in increasing N uptake by plants, 25 and 50% higher seed rate proved to be equally effective.

Rice-grain equivalent

Groundnut registered the maximum rice equivalent followed by soybean, finger millet and urdbean. Upland rice recorded minimum equivalent. Maximum equivalent with groundnut was obviously due to less crop-weed competition. Lower nutrient uptake by weeds (Table 1) and accordingly greater uptake of N by the crop (Table 2) was reflected as higher grain yield. Its higher selling price finally gave the maximum rice equivalent. Prasad and Ahmad (1988) and Rafey and Singh (1990) also reported the same result. Soybean under the region also get favourable climatic condition, so it also flourished well and gave good yield (Saha, 1990; Ram, 1997), although it has got no good market. So, it ranked next to groundnut for equivalent. Superiority of finger millet to upland rice was due to its shadier nature of growth habit which diminished weed density and biomass (Table 1). The finger millet experienced less crop-weed competition compared to upland rice, although nutrient uptake of weeds and N uptake by plants under the crops remained unaffected. Higher equivalent with urdbean compared to upland rice was only due to

higher selling price of urdbean, although grain yield of urdbean was the lowest because urdbean did not thrive well in the region even under good fertility and weed-management condition (Roy and Srivastava, 1992). Irrespective of crops, better performance during 1996 than during 1995 was due to having better climatic condition in respect of warmth, humidity and day light, although average rainfall during 1996 was less by 18 mm of all the measures, at most equivalent with recommended seed rate + hand-weeding was only due to least crop-weed competition. Least nutrient uptake by weeds and maximum N uptake by plants also supported the result. Similar equivalent in 25% higher seed rate, recommended seed and recommended seed rate + herbicide was also due to having similar magnitude of crop-weed competition. The lowest equivalent with 50% higher seed rate further supported the result. Negative correlation between weed population, weed biomass, N, P, K uptake by weeds vs rice equivalent ($r = -0.43, -0.33, -0.55, -0.29$ and -0.33 respectively) confirmed the results.

Net returns

Among the crops, groundnut proved to be the most profitable crop. In increasing net returns, soybean ranked next to groundnut. Obviously lower selling price of soybean placed it next to groundnut. Comparable net returns with finger millet and upland rice were because of adverse climatic condition during 1995 in which the crop received a heavy shower of 185.2 mm at flowering to grain-filling stage which

affected grain setting in finger millet more than in upland rice, resulting in lower grain yield in finger millet. The lowest net return in urdbean was mainly due to low yield. Of all measures, recommended seed rate + hand-weeding gave the maximum net returns. The other measures could not match with recommended seed rate + hand-weeding only because of having lower equivalent.

Benefit : cost ratio

Groundnut gave the maximum ratio and hence it proved most profitable crop under the existing agro-climatic condition. The benefit:cost ratio with finger millet and soybean was statistically at par. Therefore, both the crops proved to be less profitable. With respect to profitability, upland rice (0.94) occupied third position. However, urdbean (0.60) proved to be least remunerative. Similarly, among the measures, recommended seed rate + hand-weeding (1.14) and 25% higher seed rate (1.08) gave similar ratio and proved most effective. Compared to 50% higher seed rate (0.67), recommended seed rate (0.97) was found more profitable.

Thus, groundnut was most suitable crop for the region. Finger millet and soybean might be preferred to upland rice. Among the measures, recommended seed rate + hand-weeding or 25% higher seed rate should be preferred to make cultivation profitable, use of only recommended seed rate was not enough. It must be accompanied with either a hand-weeding or suitable herbicide or the seed rate should be increased up to 25%.

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