



Nutrient uptake in maize under different weed and nutrient management options

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ABSTRACT

Results of field experiment carried out during *Kharif* 2011 and 2012 at Instructional Farm, Rajasthan College of Agriculture, Udaipur, indicated various weed-management treatments significantly enhanced N and P uptake by maize (*Zea mays* L.) and reduced removal of nutrients by weeds as compared to weedy check. Maximum saving of 52.96% nitrogen and 51.87 % phosphorus was achieved with oxyfluorfen 0.15 kg/ha pre-emergence *fb* one hoeing 30 DAS. On pooled basis, this treatment gave 163.57% and 95.86% more grain and stover yield, respectively compared to weedy check, which was followed by metribuzin 0.25 kg/ha pre-emergence *fb* one hoeing 30 DAS. The yield as well as uptake of N and P by the crop was maximum with 150% RDF which were statistically at par with 125% RDF.

INTRODUCTION

Maize is an important cereal crop of Rajasthan during *Kharif* season. The state yield (1.78 t/ha) lagged way behind its potential yield. Maize is known to be very responsive to better management. However, weeds constitute a major problem in harnessing yield potential of maize. Reduction in yield of maize may be as high as 40-60% or even more depending upon the intensity and types of weed infestation (Thobatsi 2009). At present no herbicide is available which alone can provide desired degree of weed control in the maize crop. Moreover, the continuous use of single herbicide could be responsible for the evolution of herbicide resistance in various weed species and shift in weed flora (Pandey *et al.* 1999). Proper selection of herbicide along with proper dose and their integration with hoeing and weeding are the important considerations for lucrative returns in maize. Among the growth inputs mineral nutrition also plays a vital role in maize production. Nutrition losses caused by weeds can be effectively tackled either by effective weed management or through the use of higher fertilizer or combination of both. In view of these facts present investigation was therefore undertaken to study the extent of nutrient depletion by crop and weeds under various weed and nutrient management systems and to minimize these losses by controlling weeds.

MATERIALS AND METHODS

The experiment was conducted at Instructional Farm, Rajasthan College of Agriculture, Udaipur during *Kharif* season of 2011 and 2012. The experimental soil was clay loam, slightly alkaline, medium in available nitrogen and phosphorus and high in potassium. The experiment consisted of six weed-management treatments, *viz.* weedy check, atrazine 0.50 kg/ha pre-emergence *fb* one hoeing 30 DAS, metribuzin 0.25 kg/ha pre-emergence *fb* one hoeing 30 DAS, oxyfluorfen 0.15 kg/ha pre-emergence *fb* one hoeing 30 DAS, two hoeing 15 and 30 DAS, weed free in main plots and 4 nutrient management treatments *viz.* 75% RDF, 100% RDF, 125% RDF, 150% RDF in sub-plots. The experiment was laid out in split plot design with three replications. Maize variety "*HQPM-5*" was sown at 60 cm row spacing using 25 kg/ha seed on 7th and 8th July and harvested on 15 and 16 October in respective seasons. Application of 120 kg N and 40 kg P₂O₅/ha was done through Urea and DAP, respectively, as recommended dose of fertilizer. As per treatment whole dose of phosphorus and one-fourth dose of nitrogen was applied at the time of sowing and the remaining three-fourth dose of nitrogen was applied as top dressing in three equal splits each at 5-6 leaf stage, knee high and tasselling stage of crop growth. The size of the gross and net plot was 5.0 x 3.6 m and

4.0 x 2.4 m, respectively. Total rainfall in the respective seasons during crop period was 872.1 mm and 642.4 mm. As per treatment, herbicides (atrazine, metribuzin and oxyfluorfen) were sprayed one day after sowing as pre-emergence spray, when there was sufficient moisture in the soil. Inter-cultivation as per treatment was done at 30 DAS with hand-hoe (Kudali). Yield data on crops and dry weight of weeds were recorded at harvest. Crop was kept weed free up to 60 DAS. Observations on various parameters were taken following standard procedures.

RESULTS AND DISCUSSION

In two year field study, maize was infested with mixed flora of narrow and broad-leaved weeds. Important narrow-leaved weeds were *Cynodon dactylon*(L.), *Echinochloa colona* (L.), *Cyperus rotundus* (L.), *Brachiraria reptans* (L.) and *Dinebra arabica*(L.) while important broad-leaved weeds were *Amaranthus viridis*, *Commelina benghalensis* (L.), *Digera arvensis*(L.) and *Trianthema portulacastrum*. Out of these *Echinochloa colona* was the most dominating narrow leaved weed at the experimental site during both the years.

Dry matter

Pooled data (**Table 1**) revealed that all the weed-management treatments significantly reduced dry matter of narrow-leaved, broad-leaved and total dry matter of weeds compared to weedy check. Oxyfluorfen *fb* hand hoeing 30 DAS recorded the minimum total weed dry matter (139.08 g/m²) after weed free treatment (26.80 g/m²), however its effect

was statistically at par with metribuzin *fb* hand hoeing 30 DAS (150.83g/m²). Maximum total weed dry matter (644.37 g/m²) was recorded in weedy check. Both of herbicidal treatments integrated with hand hoeing were found significantly superior to rest of the weed control treatments in reducing the total dry matter of weeds. The better weed control under these treatments was because of the reason that pre-emergence application of these herbicides curb the germination and growth of majority of weeds for longer period possibly due to its longer persistence in soil and whatever the weeds left uncontrolled were effectively tackled by hoeing operations done 30 DAS. The results corroborated with the findings of Nadiger *et al.* (2013) and Dutta *et al.* (2016) in maize. Amongst the various nutrient management treatments, significant increase in dry matter of both broad and narrow-leaved weeds as well as total weeds at harvest was recorded by raising the fertility levels upto 125% RDF. The maximum total weed dry matter of 248.36 g/m² was recorded under 150% RDF, which was statistically at par with 125% RDF (243.20 g/m²) and minimum total weed dry matter was recorded under 75% RDF (207.29 g/m²). Significant increase in weed dry matter with increase in fertility levels might be ascribed to the fact that increasing fertility provides greater amount of nutrients to weeds which perhaps might have resulted into better growth of weeds and reflected into more dry matter accumulation by them. The observed relationship corroborate with the findings of Venkata *et al.* (2016).

Table 1. Effect of weed and nutrient management on dry matter of weeds and nutrient removal at harvest (pooled data of 2 years)

Treatment	Weed dry matter (g/m ²)			Nutrient removal by weeds (kg/ha)					
	Narrow-leaved	Broad-leaved	Total	Nitrogen			Phosphorus		
				Narrow-leaved	Broad-leaved	Total	Narrow-leaved	Broad-leaved	Total
<i>Weed management</i>									
Weedy check	494.9	149.5	644.3	72.2	25.6	97.9	12.7	4.16	16.87
Atrazine 0.5 kg/ha <i>fb</i> HW 30 DAS	170.9	31.3	202.2	25.9	5.61	31.5	4.55	0.90	5.45
Metribuzin 0.25 kg/ha <i>fb</i> HW 30 DAS	123.8	27.0	150.8	19.1	4.99	24.1	3.33	0.80	4.13
Oxyfluorfen 0.15 kg/ha <i>fb</i> HW 30 DAS	116.0	23.1	139.1	18.0	4.36	22.3	3.16	0.69	3.85
HW 15 and 30 DAS	178.3	46.8	225.1	26.5	8.35	34.8	4.71	1.35	6.06
Weed free(Up to 60 DAS)	20.3	6.5	26.8	3.2	1.24	4.5	0.56	0.19	0.75
LSD (p=0.05)	14.0	4.2	17.9	1.6	0.86	1.8	0.36	0.15	0.28
<i>Nutrient management</i>									
75% RDF	166.5	40.8	207.3	24.4	7.13	31.5	4.31	1.15	5.46
100% RDF	179.7	47.0	226.8	26.8	8.28	35.1	4.71	1.33	6.04
125% RDF	193.0	50.2	243.2	29.0	8.89	37.9	5.11	1.43	6.54
150% RDF	196.9	51.5	248.4	29.7	9.17	38.9	5.23	1.47	6.70
LSD (p=0.05)	10.4	3.2	12.8	1.2	0.64	1.23	0.23	0.09	0.19

Grain, stover and biological yield

All the weed management treatments significantly increased grain, stover and biological yields compared to weedy check on pooled basis (Table 2). The pronounced effect of increased yield was observed with oxyfluorfen fb hand hoeing 30 DAS. This resulted into increase in grain, stover and biological yield by 163.57%, 95.86% and 115%, respectively compared to the weedy check treatments. The increase in yield under various weed management treatments might be attributed to significant reduction in weed dry matter (Table 1) thereby reduction in crop-weed competition which provided congenial environment to the crop for better expression of vegetative and reproductive potential. Application of 150% recommended dose of fertilizer gave the highest grain (3.54 t/ha), stover (6.48 t/ha) and biological (10.01 t/ha) yields which were statistically at par with 125% RDF (grain 3.41 t/ha, stover 6.35 t/ha and biological yield 9.76 t/ha). The respective increase in grain, stover and biological yield under 150% RDF was 43.15, 22.41 and 29.01% compared to the lowest yield levels being recorded under 75% RDF. Higher fertility levels might have increased availability of nutrients in the soil which culminated into more absorption and higher uptake of nutrients by the crop thereby better plant growth. The favourable effect on yield could also be due to lesser competition for nutrient between crop and weeds under higher fertility levels. Results corroborate with the findings of Singh and Nepalia (2009).

Nutrient uptake by crop

All the weed management treatments significantly enhanced N and P uptake by grain,

stover as well as total uptake of these nutrients by the crop over weedy check (Table 2). The highest N and P uptake by the grain (68.4, 13.7 kg/ha), stover (48.3, 11.9 kg/ha) and total uptake (116.7, 25.6 kg/ha) by the crop was recorded with oxyfluorfen fb hand hoeing 30 DAS after weed free treatment which was closely followed by metribuzin fb hand hoeing 30 DAS. It might be ascribed to lower weed dry matter due to higher weed control efficiency with these treatments resulting in more favorable environment for growth and development of crop plants. The results confirm the findings of Mahadevaiah and Karuna (2014). The highest total uptake of nitrogen (109.6 kg/ha) and phosphorus (23.7 kg/ha) were recorded under 150% RDF which was statistically at par with 125% RDF compared with lowest (73.1 and 16.3 kg/ha respectively) recorded under 75% RDF. The nutrient uptake by the crops is mainly the function of crop yield. Therefore, considerable increase in N and P uptake by crop was attributed to higher grain and stover yield at higher fertility levels. The results are in close conformity with the findings of Nath *et al.* (2009).

Nutrient removal by weeds

All the weed management treatments resulted into significant reduction of nutrient removal by narrow-leaved, broad-leaved and total uptake of these nutrients by the weeds compared to weedy check. The least drain of total N (22.35 kg/ha) and P (3.85 kg/ha) by weeds was recorded under oxyfluorfen fb hand hoeing 30 DAS treatment which was closely followed by metribuzin fb hand hoeing 30 DAS (Table 1), while the maximum removal of nutrients

Table 2. Effect of weed and nutrient management on yield and nutrient removal by maize at harvest (pooled data of 2 years)

Treatment	Yield (t/ha)			Nutrient removal by crop (kg/ha)					
	Grain	Stover	Biological	Nitrogen			Phosphorus		
				Grain	Stover	Total	Grain	Stover	Total
<i>Weed management</i>									
Weedy check	1.40	3.55	4.96	23.7	20.21	43.91	4.25	4.86	9.11
Atrazine 0.5 kg/ha fb HW 30 DAS	3.09	5.94	9.03	53.2	37.11	90.31	10.29	9.03	19.32
Metribuzin 0.25 kg/ha fb HW 30 DAS	3.55	6.59	10.15	62.73	44.31	107.0	12.68	10.95	23.63
Oxyfluorfen 0.15 kg/ha fb HW 30 DAS	3.69	6.96	10.66	68.36	48.34	116.7	13.68	11.93	25.61
HW 15 and 30 DAS	2.94	5.76	8.70	50.39	35.65	86.04	9.75	8.71	18.46
Weed free (Up to 60 DAS)	3.85	7.22	11.07	71.4	51.96	123.4	14.65	12.64	27.29
LSD (p=0.05)	188	390	508	4.05	3.56	7.73	0.92	0.89	1.59
<i>Nutrient management</i>									
75% RDF	2.47	5.29	7.76	40.04	33.03	73.07	8.22	8.08	16.3
100% RDF	2.94	5.91	8.85	51.96	38.42	90.38	10.22	9.4	19.62
125% RDF	3.41	6.35	9.76	62.54	42.69	105.2	12.26	10.45	22.71
150% RDF	3.54	6.48	10.01	65.31	44.25	109.6	12.84	10.82	23.66
LSD (p=0.05)	127	267	348	2.79	2.46	4.53	0.6	0.58	1.22

(97.90 kg N and 16.87 kg P/ha) was recorded under weedy check. Significantly higher removal of N and P by narrow leaved, broad leaved and total uptake of these nutrient by the weeds were found under 100,125 and 150% RDF compared to 75% RDF. The uptake of N and P by weeds was estimated as 69.04% and 64.93%, respectively, of the total removal (weed + crop) in weedy check and only 16.07% and 13.07% in oxyfluorfen *fb* hand hoeing 30 DAS and 18.36% and 14.88% in metribuzin *fb* hand hoeing 30 DAS treatment. Thus saving of 52.96% N and 51.87% P could be obtained by the adoption of treatment oxyfluorfen *fb* hand hoeing 30 DAS while the respective saving of these nutrients under in metribuzin *fb* hand hoeing 30 DAS treatment was 50.67% and 50.06%. The uptake of N and P by the crop and weeds could be mainly attributed to their dry matter production. It is apparent from table 1 and 2 that whenever the removal of nutrients by weeds was more, corresponding uptake by the crop was less and vice-versa. Therefore, for efficient utilization of applied nutrients the weeds should be kept under control. On the basis of two years investigation on weed and nutrient management, it can be concluded that pre-emergence application of 0.15 kg oxyfluorfen / ha in conjugation with hoeing 30 DAS resulted in highest nutrient uptake by crop as well as the highest yield of quality protein maize. Under nutrient management treatments, 125% RDF (150 kg N and 50 kg P₂O₅) may be applied for maximization of nutrient uptake by crop and thereby yield.

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