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Effect of post-emergence herbicides on nutrient uptake by weeds and potato (*Solanum tuberosum*)

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ABSTRACT

A field experiment was conducted during winter (*rabi*) seasons of 1995–96 and 1996–97 at Hisar, to study the effect of post-emergence herbicides on nutrient uptake by weeds and crop in potato (*Solanum tuberosum* L.). The field was dominated mainly by broad leaf weeds like *Chenopodium album* L. (50%), *Melilotus alba* Desr. (35%) and *Coronopus didymus* (15%). All the weed-control treatments significantly reduced the dry weight of weeds and N, P and K uptake by weeds compared with weedy check. Among herbicides, minimum nutrient uptake by weeds and maximum by crop was recorded in the plots treated with linuron + metribuzin (2 : 1) at 1.00 kg/ha, and it also recorded highest tuber yield which was at par with weed-free check. The maximum nutrient uptake by weeds and minimum by crop with lowest tuber yield was found in weedy check, followed by glufosinate.

Key words : Potato, Weed control, Tuber yield, Herbicides

Potato is one of the most important food as well vegetable crops of world and is capable of producing more weight and calories per unit area as compared with all other crops (Dass, 1993). Yield losses go as high as 40–65% or even more due to weeds alone depending upon their infestation (*Tripathi et al.*, 1989). Besides, space, light and moisture weeds also compete for nutrients with the main crop and remove as high as 94.2 kg N, 17.1 kg P_2O_5 and + 91.6 kg K_2O/ha (Prasad and Singh, 1995). Manual weeding is no doubt quite effective, but it is time consuming, costly, tedious and may cause root injury and disturbs root system in the later stages of crop growth (Khurana *et al.*, 1993). Under such situations chemical weeding is better, as it is economical, easy and efficient. Therefore the present investigation was planned to see the effect of post-emergence herbicides on nutrient removal by weeds and crop.

MATERIALS AND METHODS

A field experiment was carried out during the winter (*rabi*) seasons of 1995–96 and 1996–97 at Research Farm, CCS

Haryana Agricultural University, Hisar. The soil of experimental field was sandy loam in texture, slightly alkaline in reaction (pH 8.01), low in available N (201 kg/ha), medium in available P (16.1 kg/ha) and rich in available K (401 kg/ha). The potato var. 'Kufri Chandramukhi' was planted on 24 and 25 October during 1995–96 and 1996–97 respectively, keeping the spacing of 60 cm × 15 cm and the crop was raised as per recommended package of practices. Fifteen weed-control treatments consisted of linuron 0.75 and 1.00, atrazine 0.15 and 0.20, metribuzin 0.75 and 1.00 kg/ha and glufosinate at 0.3 and 0.5% and tank mixture of linuron with atrazine (5 : 1) and with metribuzin (2 : 1) at 0.75 and 1.00 kg/ha and 2 hand-weedings (H.W.) at 20 and 45 days after planting (DAP) compared with weed-free and weedy check. The experiment was laid out in randomized block design with 3 replications. Herbicides were sprayed at 15 DAP (5–10% plant emergence) using knapsack sprayer fitted with flat-fan nozzle using 625 litres water/ha. The data on total weed dry weight was recorded at 60 days during both the years. The N, P and K contents in potato tuber and haulm and also of the total weeds were determined separately at harvest only in the second year. Uptake of N, P and K was calculated by multiplying the nutrient content with their respective oven-dry weights.

RESULTS AND DISCUSSION

Weight of weeds

The experimental field was infested mainly with *Chenopodium album* L. (50%), *Melilotus alba* Desr. (35%) and *Coronopus didymus* (15%). Hand-weeding at 20 and 45 days and application of herbicides alone or tank mixed controlled all the weeds significantly compared with weedy check (Table 1). Tank mixture of linuron + metribuzin at 0.75 and 1.00 kg/ha or metribuzin alone at 0.55 kg/ha was at par with each other and most effective in reducing weed dry weight compared with all other herbicides. Glufosinate and atrazine applied alone were least effective against these weeds. In general, the effect of herbicides alone or in mixture increased with the increase in their doses. Efficacy of linuron increased when used as mixture. However, the performance of linuron with metribuzin was superior to its combination with atrazine during the second year. Results confirm the findings of the Reddy *et al.*, (1994) and Hvelplund (1996).

Nutrient uptake by weeds

The uptate of N, P and K was significantly lower in all the weed-control treatments than the weedy check (Table 1). This may be due to luxuriant growth of weeds in unweeded check which might have competed strongly with the crop plants for nutrients. The uptake of nutrients in the weeds is governed by their dry-matter production and nutrient content. As the nutrient content was not influenced significantly by the herbicide and hand-weedings, the nutrient uptake was governed only by the dry-matter accumulation by weeds. Application of herbicides alone or their mixtures and hand-weedings reduced the dry-matter production of weeds and consequently reduced their N, P and K uptake.

Table 1. Effect of different herbicides on weed dry weight, N, P and K content and uptake by weeds

Treatment	Dose (kg/ha)	Dry weight of weeds at 60 DAP (g/m^2)		Content at harvest (%) (1996–97)			Uptake at harvest (kg/ha) (1996–97)		
		1995–96	1996-97	N	P	K	N	P	K
Linuron	0.75	43.3	26.8	2.16	0.24	2.74	16.4	1.03	20.8
Linuron	1.00	37.5	24.5	2.14	0.22	2.76	14.7	1.51	18.9
Linuron + atrazine (5 : 1)	0.75	23.8	18.1	2.15	0.25	2.73	12.1	1.41	15.4
Linuron + atrazine (5 : 1)	1.00	9.7	17.5	2.19	0.22	2.75	10.3	1.03	12.9
Glufosinate	0.3%		69.2	2.21	0.24	2.74	32.4	3.50	40.3
Glufosinate	0.5%		66.7	2.16	0.25	2.72	29.4	2.40	36.9
Atrazine	0.15	45.2	52.3	2.15	0.24	2.76	20.8	2.30	26.8
Atrazine	0.20	36.0	44.5	2.17	0.28	2.73	19.4	2.51	24.4
Linuron + Metribuzin (2 : 1)	0.75	23.4	15.1	2.19	0.27	2.73	10.0	1.21	12.4
Linuron + Metribuzin (2:1)	1.00	10.4	13.1	2.20	0.24	2.78	7.2	0.78	9.1
Metribuzin	0.44	23.5	15.4	2.15	0.26	2.74	11.7	1.42	15.0
Metribuzin	0.55	8.4	13.5	2.16	0.25	2.77	9.2	1.07	9.2
Two hand-weedlings 20 and 45 DAP		16.8	11.4	2.14	0.24	2.76	11.3	1.26	14.6
Weedy check		238.5	99.5	2.18	0.25	2.75	51.2	5.80	64.6
Weed-free		0.000	0.00	0.00	0.00	0.00			
CD (P=0.05)		11.4	6.3	NS	NS	NS	3.7	0.37	4.7

Table 2. Effect of different herbicides on N, P and K content, uptake and tuber yield of potato

Treatment	Dose (kg/ha)	Contents (%) (1996–97)						Uptake (kg/ha) 1996–97			Tuber yield (kg/ha)	
		N		P		K						
		Halums	Tubers	Halums	Tubers	Halums	Tubers	N	P	K	1995-96	1996–97
Linuron	0.75	2.28	1.92	0.21	0.19	3.23	2.58	50.8	4.90	69.4	112.9	137.1
Linuron	1.00	2.29	1.84	0.22	0.18	3.18	2.62	53.4	5.17	70.0	114.2	143.5
Linuron + Atrazine (5:1)	0.75	2.31	1.86	0.20	0.18	3.29	5.59	56.5	5.25	78.4	115.0	149.3
Linuron + Atrazine (5:1)	1.00	2.34	1.88	0.21	0.19	3.17	2.55	58.4	5.65	78.9	109.0	154.2
Glufosinate	0.3%	2.34	1.94	0.22	0.17	3.24	2.59	27.3	2.47	37.1		-53.3
Glufosinate	0.5%	2.27	1.93	0.21	0.18	3.29	2.63	31.7	2.89	43.7		65.1
Atrazine	0.15	2.32	1.90	0.20	0.18	3.31	2.65	35.0	3.27	50.6	90.7	80.3
Atrazine	0.20	2.35	1.92	0.20	0.19	3.22	2.63	40.4	3.75	55.1	92.5	88.2
Linuron + Metribuzin (2:1)	0.75	2.33	1.87	0.21	0.18	3.17	2.52	65.0	6.12	87.8	116.6	164.1
Linuron + Metribuzin (2:1)	1.00	2.35	1.89	0.22	0.19	3.19	2.60	69.0	6.78	94.4	119.2	178.6
Metribuzin	0.44	2.30	1.95	0.22	0.18	3.21	2.50	63.4	5.89	83.2	121.4	159.2
Metribuzin	0.55	2.35	1.93	0.21	0.19	3.17	2.55	67.7	6.45	89.7	124.0	170.2
Two hand-weedlings 20 and 45 DAP		2.28	1.94	0.20	0.18	3.29	2.63	61.9	5.72	89.8	117.2	160.2
Weedy check		2.29	1.90	0.20	0.19	3.30	2.62	17.8	1.63	25.1	39.3	24.3
Weed-free		2.36	1.95	0.22	0.19	3.27	2.64	73.1	7.04	99.8	126.9	186.3
CD (P=0.05)		NS	NS	NS	NS	NS	NS	8.2	0.84	13.0	15.6	17.3

Weeds removed 51.2, 5.8 and 64.6 kg N, P and K/ha, respectively, under weedy check, whereas this removal was only 7.2, 0.8 and 9.1 kg N, P and K/ha respectively in the plots treated with linuron + matribuzin 1.00 kg/ha, followed by metribuzin 0.55 kg/ha. Among the herbicides, maximum nutrient uptake was recorded with glufosinate. These findings confirm those of Singh (1992), Singh and Lal (1994) and Prasad and Singh (1995).

Tuber yield of potato

All the weed-control treatments increased the tuber yield significantly compared with weedy check (Table 2). Linuron + metribuzin at 1.00 kg/ha and metribuzin at 0.55 kg/ha gave tuber yields and stastically at par with weed-free check. The tuber yield in linuron at 0.75 and 1.00 kg/ha, linuron + atrazine or linuron + metribuzin at 0.75 kg/ha, metribuzin at 0.44 kg/ha and 2 hand-weedings at 20 and 40 DAP was at par with weed-free treatment only during 1995–96. In spite of satisfactory weed control, lower tuber yield with linuron + atrazine at higher doses might be due to the crop phytotozicity. Atrazine or glufosinate applied alone gave poor weed control, resulting in the significantly lower potato yield than other herbicidal treatments. Weeds growing throughout the crop season reduced the crop yield by 69 and 81% during first and second year respectively. Lower yields in plots with 2 hand-weedings might be due to the possible weed competition at the later stages of crop growth. Khurana *et. al.* (1993) also reported similar results.

Nutrient uptake by Crop

Beneficial effect of the weed-control treatments in reducing the nutrient drain by weeds was reflected in significantly increased uptake of N, P and K by crop than that under the weedy check. As the nutrient content was not influenced by different weed-control treatments, the nutrient uptake followed the yield pattern in various treatments. The application of herbicides or hand-weeding resulted in more uptake of nutrients by the crop because they reduced the weed dry weight which ultimately resulted in higher tuber yield. Under the weedy check condition, crop could utilize minimum nutrients (17.8, 1.63 and 25.1 kg N, P and K/ha respectively), whereas under linuron + metribuzin 1.00 kg/ha, it utilized 69.0. 6.78 and 94.4 kg/ha N, P and K, respectively, being 51.2, 5.15 and 69.3 kg/ha more N, P and K than that of weedy check. Highest uptake of nutrient was recorded in weed-free conditions. Thus weed-control practices provided the crop with favourable conditions for better growth, tuber yield and efficient use of nutrients.

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