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Effect of different weed management practices on weeds density, yield, nutrient use efficiency, productivity and economics of potato (*Solanum tuberosum* L.)

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ABSTRACT

Field studies were conducted at Potato Research Station, S. D. Agricultural University, Deesa during 2013-14 and 2014-15 to study the effect of different weed management practices on weeds density, yield, nutrient use efficiency, productivity and economics of potato. Results showed that pre-emergence application of metribuzin @ 0.75 kg/ha significantly reduced species-wise and total weed densities. Consequently, markedly higher tuber yield along with improved nutrient use efficiencies, water and crop productivities and net returns were registered under pre-emergence application of metribuzin @ 0.75 kg/ha. Hand weeding at 40 days after planting and weed free till maturity also recorded for significantly higher in tuber yield and profits.

Key words: Economics, potato, productivity, yield, weed density

Potato is an annual crop which plays an important role in human sources of food. Potato tubers are rich in nutrients such as carbohydrates, proteins and amino acids. India is the second largest producer of potato in the world, contributing about 12 per cent of the world's potato production (FAOSTAT, 2016). Weed infestation decrease the quality and quantity of potato tubers via decreasing size, weight and number of tubers (Arnold *et al*., 1997). Due to the long time from sowing to emergence of potato in the fields, and wider spacing among the rows, weeds have enough opportunity for their growth using abundant water and nutrients which directly leads to rapid growth of weeds and decreasing the crop yield from 10% to 80% (Rana *et al*., 2005; Tomar *et al*., 2008). Therefore, weeds must be removed in an appropriate time using suitable herbicide or other weed management practice for achieving optimum yield potato fields. Hence, an experiment was planned to evaluate the effect of different weed management practices on weeds, yield, nutrient use efficiency, productivity and economics of potato.

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MATERIALS AND METHODS

A field experiment was conducted at Potato Research Station, SDAU, Deesa (Gujarat) during *Rabi* seasons of 2013-14 and 2014-15 to study the effect of different weed management practices on weeds, yield, nutrient use efficiency, productivity and economic of potato. The soil was loamy sand in texture, low in organic carbon (0.31%), available nitrogen (170.02 kg/ha), medium in available phosphorus (29.92 kg/ha) and available potassium (297.00 kg/ha). Seven treatments *viz*; weedy check, weed free, hand

weeding (HW) at 30 days and weed free up to maturity, HW at 40 days and weed free up to maturity, HW at 50 days and weed free up to maturity, metribuzin 0.75 kg/ha (pre-emergence) and metribuzin 0.75 kg/ha (post-emergence at 10% plant emergence) were laid out in randomized block design and replicated four times. Recommended dose of fertilizer for potato was 275:140:275 kg N: P_2O_5: K_2O/ha. Potato variety Kufri Badshah was sown on 15th November with seed rate of 3000 kg/ha at a spacing of 50 cm x 20 cm. Recommended package of practice were followed for potato crop during the experiment. Weed density was counted at 50 days at planting (DAP) by using 0.5 m x 0.5 m quadrant from plot which was further classified into different species i.e; grasses, broadleaf weeds (BLW) and total weeds and later expressed in terms of number per m^2. Total tuber yield at harvest from each net plot of size 3.0 m x 4.0 m was further classified into different grades *i.e*, 0-25 g, 25-50 g, 50-75 g and >75 g and later expressed in t/ha. Weed index (%), crop productivity (kg/ha/day), water productivity (kg/ha/mm) and Nutrient use efficiency of N, P and K (kg tuber/kg nutrient applied) were calculated by using standard formula. Total duration of crop was 97 days during all the years of experimentation and the total amount of irrigation water used in irrigation was 700 mm.

Weed density data were subjected to square root transformation before statistically analysis. Data were statistically analysed using OPSTAT of CCSHAU, Hisar and interpreted accordingly.

RESULTS AND DISCUSSION

Weed densities and tuber yields

Perusal of the data (Table 1) revealed that weed densities in potato were significantly influenced by different weed management practices. Both pre-emergence and post-emergence application of metribuzin 0.75 kg/ha recorded significant reduction in densities of BLW (0.77/m^2) and grasses (0.43/m^2) and total weed (1.2/m^2). All grade-wise tuber yields and total tuber yield except 0-25 g tuber yield were significantly varied by various treatments (Table 1). Significantly highest 25-50 g grade tuber yield (5.31 t/ha) was registered under pre-emergence application of metribuzin 0.75 kg/ha which significantly higher than weed free at 30 days and weed free up to maturity and HW at 50 days and weed free up to maturity and metribuzin 0.75 kg/ha (Post-emergence). Pre-emergence application of metribuzin 0.75 kg/ha markedly increased 50-75 g (13.49 t/ha) and >75 g (10.54 t/ha) grade tuber yield, which was 48.24 % and 21.0% higher than weedy check, respectively. In case of total tuber yield, weed free check recorded significantly higher tuber yield (33.10 t/ha), however pre-emergence application of metribuzin 0.75 kg/ha had statistically higher yield (31.52 t/ha) than weedy check and post-emergence application of metribuzin 0.75 kg/ha, which was at the tune of 30.08% and 12.45%, respectively. Yield reduction due to weeds (WI) among all weed management practices was lowest under pre-emergence application of metribuzin 0.75 kg/ha (5.01%). This was due to lower weed infestation under pre-emergence application of metribuzin which resulted in better crop growth with lower crop-weed competition for nutrients and water. Improved growth and development of crop under this treatment later translated into higher tuber yield, which was corroborated by findings of Kumar *et al.* (1998), Mukherjee *et al.* (2012) and Zarzecka *et al.* (2004).

NUE, productivities and economics

It was evident from Table 2 that NUE and productivities were varied significantly due to different treatments. Pre-emergence application of metribuzin 0.75 kg/ha recorded markedly higher NUE of N (114.61 kg tuber per kg N applied), P (225.12 kg tuber per kg N applied) and K (114.61 kg tuber per kg N applied) over rest of weed management practices, except HW at 50 days and weed free up to maturity. Similarly, water (71.25 kg/ha/mm) and crop (324.91 kg/ha/day) productivities of potato were significantly increased under pre-emergence

application of metribuzin 0.75 kg/ha over weedy check and post-emergence application of metribuzin 0.75 kg/ha. This was attributed to lower crop-weed competition which resulted in better utilization of nutrients and water and ultimately realized into enhanced growth and yield of crop under pre-emergence application of metribuzin 0.75 kg/ha.

Highest net return was recorded under weed free (₹ 71.48 x 10^3/ha) which was closely followed by pre-emergence application of metribuzin 0.75 kg/ha (₹ 71.25 x 10^3/ha) and HW at 40 days and weed free up to maturity (₹ 63.06 x 10^3/ha). Similarly, weed free had highest return per day (₹ 736.90 /ha/day) which was statistically at par with pre-emergence application of metribuzin 0.75 kg/ha (₹ 734.54 / ha / day) which was followed by HW at 40 days and weed free up to maturity (₹ 650.13/ha/day). However, in case of BCR, pre-emergence application of metribuzin 0.75 kg/ha had highest value of BCR (0.83), which was closely followed by weed free (0.76) and HW at 40 days and weed free up to maturity (0.71). The reason behind higher profitability in pre-emergence application of metribuzin 0.75 kg/ha was higher tuber yield, which increased economic returns and BCR.

CONCLUSION

Based on above findings, it can be concluded that application of Metribuzin 0.75 kg/ha as pre-emergence herbicide can be followed to achieve higher tuber yield and profitability in potato along with efficient utilization of irrigation water and nutrients. In case of higher labour availability, hand weeding can be started from 40 days after planting and keep weed free till maturity for higher tuber yield and economic remuneration.

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Table1 Weed density, tuber yields and WI as influenced by different weed management practices in potato (Pooled data of two years)

Treatment	Weed density (No./ m^2) at 50 DAP			Grade-wise tuber yield (t/ha)					WI (%)
	BLW	Grasses	Total	0-25 g	25-50 g	50-75 g	>75 g	Total	
Weedy check	2.12 (4.03)	1.63 (2.17)	2.58 (6.20)	2.20	4.23	9.10	8.71	24.23	26.80
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	1.94	5.14	13.87	12.15	33.10	0.00
HW at 30 days and weed free up to maturity	1.55 (1.93)	1.01 (0.52)	1.71 (2.44)	1.77	3.91	12.41	11.20	29.29	11.51
HW at 40 days and weed free up to maturity	1.73 (2.52)	1.09 (0.70)	1.92 (3.22)	2.08	4.90	12.85	10.58	30.41	8.13
HW at 50 days and weed free up to maturity	1.76 (2.60)	1.46 (1.63)	2.18 (4.23)	1.75	3.56	12.57	11.47	29.35	11.33
Metribuzin 0.75 kg/ha (pre-emergence)	1.12 (0.77)	0.96 (0.43)	1.30 (1.20)	2.18	5.31	13.49	10.54	31.52	5.01
Metribuzin 0.75 kg/ha (post-emergence)	1.28 (1.15)	0.98 (0.46)	1.44 (1.60)	1.85	4.22	11.62	10.34	28.03	15.32
SEd±	0.09	0.04	0.12	0.19	0.56	0.91	0.93	1.42	
CD (P=0.05)	0.26	0.11	0.26	NS	1.19	1.94	1.96	3.00	

*Figures in parentheses are original values

Table 2 NUE, water and crop productivities and economics as influenced by different weed management practices in potato (Pooled data of two years)

Treatment	NUE (kg tuber per kg nutrient applied)			Water productivity (kg/ha/mm)	Crop productivity (kg/ha/day)	Net return (₹ x 10^3/ha)	Return per day (₹/ha/day)	BCR
	N	P	K					
Weedy check	88.12	173.10	88.12	34.17	249.83	34.17	352.23	0.39
Weed free	120.35	236.40	120.35	71.48	341.19	71.48	736.90	0.76
HW at 30 days and weed free up to maturity	106.53	209.25	106.53	55.47	302.01	55.47	571.90	0.61
HW at 40 days and weed free up to maturity	110.59	217.23	110.59	63.06	313.53	63.06	650.13	0.71
HW at 50 days and weed free up to maturity	106.74	209.67	106.74	53.77	302.62	53.77	554.34	0.58
Metribuzin 0.75 kg/ha (pre-emergence)	114.61	225.12	114.61	71.25	324.91	71.25	734.54	0.83
Metribuzin 0.75 kg/ha (post-emergence)	101.94	200.23	101.94	53.83	288.99	53.83	554.93	0.62
SEd±	5.15	10.11	5.15	7.08	14.59	7.08	72.96	0.08
CD (P=0.05)	10.90	21.41	10.90	14.98	30.90	14.98	154.48	0.17