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Effect of Weed Interference and Fertilizer Levels on Weeds and Productivity of Potato

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ABSTRACT

Unchecked weed growth throughout growing period caused 52% reduction in tuber yield of potato. Weed-free condition beyond 45 days had no significant effect on tuber yield of potato. The critical period of crop-weed competition was between 15-45 days after planting (DAP) during which weed-free maintenance would be required for achieving the maximum tuber yield of potato under vertisol. The highest tuber yield of potato (17.90 t ha^{-1}) was recorded with $N_{120}P_{60}K_{60}$ under low weed pressure, while the lowest (4.07 t ha^{-1}) with $N_0P_0K_0$ under high weed pressure, which indicated that maximum fertilizer use efficiency (49 kg tuber yield kg^{-1} nutrient applied) could be obtained in the absence of weed competition. However, per cent increase in tuber yield of potato with increasing levels of fertilizer was more pronounced under high weed pressure compared to low weed pressure.

INTRODUCTION

Crop-weed competition in potato has long been established as a major deterrent for its low productivity. Decrease in tuber yield to the extent of 30-50% has been reported due to weed interference in potato under different agro-ecological situations (Bourde *et al.*, 2001; Singh *et at.*, 2002). Potato being slow growing at early stages of growth takes more time to attain close canopy and also wider spacing provides conducive condition for luxuriant growth of the weeds particularly in vertisol (black cotton soil of *kheri* series). This results in substantial reduction in tuber yield of potato. Besides this, the fertilizer and irrigation requirement of the crop is quite high which also encourages the growth of weeds and reduces the production potential, if no weed control measures are taken during critical crop growth period. Identification of critical period of crop-weed competition is one of the most important factors in crop production. Information on this aspect in vertisol (black cotton soil of *kheri* series) is lacking. The present investigations were, therefore, undertaken to find out the critical period of crop-weed competition in potato grown under vertisol and to examine the influence of different weed pressures on crop productivity under different fertilizer levels.

MATERIALS AND METHODS

Two field experiments were conducted during the winter seasons of 2000-01 and 2001-02 at National Research Centre for Weed Science, Jabalpur. The soil of experimental site was clay loam having low available nitrogen, medium available phosphorus and high available potassium, with organic carbon 0.55% and pH 6.5. In both the experiments, potato variety 'Kufri Chandramukhi' was planted during the first week of November at 60 cm x 15 cm spacing. The crop was irrigated immediately after planting through sprinkler to ensure proper tuber germination. Weed population was recorded at harvest by placing a quadrate of 0.50 m x 0.50 m (0.25 m^2) size randomly at four places in a plot. Weed dry weight was recorded at the time of weed removal after completion of respective weedy periods and at harvest in rest of the treatments.

Treatments for the study of critical period of crop-weed competition consisting of weedy and weed-free each for initial 15, 30, 45, 60 days after planting (DAP) and upto harvest were arranged in randomized block design with three replications. The crop was raised as per recommended package of practices.

Effect of different weed pressures on the performance of potato under different fertilizer levels was studied under three fertilizer levels ($N_0P_0K_0$, $N_{60}P_{30}K_{30}$ and $N_{120}P_{60}K_{60}$) as main factor and three weed pressures (Low weed pressure where metribuzin at 0.5 kg ha^{-1} was applied fb one weeding at 30 DAP, medium weed pressure where plots were treated with metribuzin at 0.5 kg ha^{-1} and high weed pressure where plots were kept weedy throughout growing period) as a sub-factor, were replicated thrice in factorial randomized block design. The levels of weed pressure recorded in terms of weed density were 62, 44 and 31 m^{-2} in high, medium and low weed pressure treatments, respectively. As per treatments, half nitrogen and full phosphorus and potassium fertilizers were applied in rows as basal dose and rest half nitrogen was top dressed at 30 DAP. Metribuzin was sprayed 2 DAP with knapsack sprayer fitted with flat fan nozzle using 600 litres water ha^{-1}.

RESULTS AND DISCUSSION

Crop-weed Competition

The field was infested with *Chenopodium album* (22%), *Medicago hispida* (21%), *Lathyrus aphaca* (17%), *Avena sterilis* ssp. *ludoviciana* (13%) and *Phalaris minor* (7%). Unchecked weeds caused 52% reduction in tuber yield of potato. Significantly highest weed population and its dry weight were recorded in the plots kept weedy upto harvest followed by weed-free for the first 15 DAP. Total weed dry matter production per unit area throughout the growing period increased with increasing duration of weedy period and vice-versa (Table 1). The tuber yield of potato significantly increased with increasing period of weed-free condition from 15 to 45 DAP only and decreased with increased weedy condition. The reduction in tuber yield with delayed weed removal was due to increased weed-crop competition as evident from progressive increase in weed dry matter accumulation. The highest tuber yield was recorded with weed-free upto harvest (22.63 t ha^{-1}) which was at par with weed-free for initial 45 days. The tuber yield recorded in weed-free for first 45 days was almost equal to the yield recorded with weedy for the first 15 days. Therefore, it may be concluded from this study that weed-free maintenance from 15 to 45 DAP would be required for achieving maximum tuber yield of potato under vertisol.

Performance of Potato under Different Weed Pressures and Fertilizer Levels

The predominant weed flora were *P. minor* and *A. sterilis* ssp. *ludoviciana* constituting more than 45% and *C. album, Cichorium intybus, Rumex*

Table 1. Effect of weedy and weed-free periods on weeds and tuber yield of potato (Average of two seasons)

Treatment	Weed density at harvest (No. m^{-2})	Weed dry weight (g m^{-2})	Tuber yield (t ha^{-1})
Weedy for the first			
15 DAS	0.71 (0.00)	5.6 (30.9)	21.00
30 DAS	0.71 (0.00)	10.4 (107.7)	17.25
45 DAS	0.71 (0.00)	13.0 (168.5)	14.50
60 DAS	0.71 (0.00)	23.4 (547.0)	11.92
Upto harvest	8.98 (80.14)	25.2 (634.5)	10.69
Weed-free for the first			
15 DAS	5.76 (32.68)	16.1 (258.7)	13.50
30 DAS	4.50 (19.75)	8.5 (71.8)	18.15
45 DAS	4.00 (15.50)	5.6 (30.9)	21.02
60 DAS	3.92 (14.87)	5.6 (30.9)	22.37
Upto harvest	0.71 (0.00)	0.7 (0.0)	22.62
LSD (P=0.05)	0.66	-	2.62

Values in parentheses are original.

Table 2. Density and dry matter production of weeds and tuber yield of potato under different weed pressures and fertilizer levels (Average of two seasons)

Treatment	Weedy (High weed pressure)	Metribuzin 0.5 kg ha^{-1} (Medium weed pressure)	Metribuzin 0.5 kg ha^{-1} fb one weeding (Low weed pressure)	Mean
		Weed density (No. m^{-2})		
$N_0P_0K_0$	7.68 (58.5)*	6.63 (43.5)	4.73 (21.9)	6.34 (39.7)
$N_{60}P_{30}K_{30}$	7.93 (62.4)	6.74 (44.9)	6.21 (38.1)	6.96 (47.9)
$N_{120}P_{60}K_{60}$	8.15 (65.9)	6.60 (43.0)	5.95 (34.9)	6.91 (47.3)
Mean	7.92 (62.2)	6.65 (43.7)	5.64 (31.3)	
LSD (P=0.05)	F–NS	WP–0.49	F x WP–NS	
		Weed dry weight (g m^{-2})		
$N_0P_0K_0$	62.7	44.6	27.1	44.8
$N_{60}P_{30}K_{30}$	75.1	53.7	37.5	53.8
$N_{120}P_{60}K_{60}$	82.5	54.0	28.8	55.1
Mean	73.4	50.8	29.5	
LSD (P=0.05)	F–NS	WP–11.9	F x WP– NS	
		Tuber yield (t ha^{-1})		
$N_0P_0K_0$	4.07	5.36	6.63	5.35
$N_{60}P_{30}K_{30}$	8.67	11.72	12.81	11.07
$N_{120}P_{60}K_{60}$	11.67	15.92	17.90	15.16
Mean	8.14	11.00	12.45	
LSD (P=0.05)	F–2.04	WP–2.04	F x WP–NS	

Values in parentheses are original.
NS–Not Significant.

hispida and *Melilotus alba* shared rest of the total weed population. Fertilizer levels did not influence significantly the weed density and its dry weight under different weed pressures (Table 2). Different fertilizer levels and weed pressures influenced significantly the tuber yield of potato. The tuber yield increased with increasing levels of fertilizer under all the weed pressures. Highest tuber yield of potato (17.90 t ha^{-1}) was recorded with $N_{120}P_{60}K_{60}$ under low weed pressure, while lowest (4.07 t ha^{-1}) with $N_0P_0K_0$ under high weed pressure. $N_{60}P_{30}K_{30}$ level of fertilizer under low weed pressure produced tuber yield as high as with $N_{120}P_{60}K_{60}$ under high weed pressure. Highest fertilizer use efficiency (44-53%) was recorded with low to medium weed pressures as compared to high weed pressure. Higher fertilizer use efficiency could be obtained in the absence of weed competition. However, per cent increase in tuber yield of potato with increasing levels of fertilizer was more pronounced under high weed pressure compared to low weed pressure. The reason could be linear response of increasing fertilizer levels due to more crop-weed competition for nutrients at high weed pressure.

REFERENCES

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