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An integration of weed management practices in potato under New Alluvial soil

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A B S T R A C T

To study the effect of different weed control measures on the yield of potato, a field experiment was carried out with this crop (var. Kufri-Jyoti) for two consecutive years (2009-10; 2010-11) at 'C' Block farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal. The experiment was laid out in RBD with nine treatments replicated thrice. The predominant weed flora in the experimental field of potato was *Cyperus rotundas, Chenopodium album, Anagallis arvensis* and *Fumaria purviflora*. The results revealed that the maximum tuber yield and return per rupee invested *vis-à-vis* the maximum N, P, K uptake by potato and the minimum uptake of N, P and K by weeds emerged in the potato field were recorded under the treatment T_3 (hand weeding at 20 DAP along with mulching) which was closely followed by the treatment T_9 (Pendimethalin @1kg a.i. ha^{-1} along with mulching). So, the findings of the experiment provide us with a great opportunity of using herbicides and mulching in combination to cope up with the labour crisis and minimize the cost of cultivation, therefore, maximizing benefit cost ratio.

Keywords: Weed management, potato, new alluvial soil

Introduction

Severe infestation of weeds in potato field offers the major obstacle to achieve higher yield. Weeds are the silent but virulent robbers of plant nutrients, moisture and solar energy. It also occupies the space which would otherwise be available to the main crop, harbour of insect-pests and disease causing organisms, cause adverse allelopathic effects, and increase cost of production. From the time immemorial the farmers are quite acquainted with the weeds of different categories infesting different crops at different seasons, but they were quite indifferent towards controlling them owing to the fact that they could not feel that such a tremendous loss could have been caused by weeds. Later on, in spite of taking proper plant protection measures in relation of disease and insect-pest management, a considerable loss in crop yield even to the extent of cent percent in certain crops like potato and jute urged them to take recourse to proper weed control measures. For combating weed menace, manual weeding is usually practiced, but it is labour intensive, tedious, back breaking and does not ensure weed removal at critical stage of crop-weed competition. For the last many years, a number of herbicides like butachlor, thiobencarb and anilofos are being applied as pre-emergence for effective control of weeds (Budha *et al.* 1991). The main reasons behind the recent trend of gaining popularity of these herbicides are crop and weed seedlings look

similar which cannot easily be differentiated even by skilled labourers; labour wage is sometimes quite high or labourers are not available during the peak period of agricultural operation; and cost of chemical weeding is sometimes less than that of hand weeding. It has also been noted that no single herbicide is effective enough to keep all the weeds under control for a long time. For this reason, the concept of integrated weed management is gradually gaining popularity. Considering these views, the present investigation was undertaken to i) identify and enlist the important weed flora of potato, ii) study the effect of different weed control measures on the yield of this crop, iii) measure the uptake of nutrients by the crop and weeds, and iv) analyse the cost effectiveness of different weed control measures.

Materials and Methods

A field experiment was conducted during the year of 2009-10 and 2010-11 at 'C' Block farm of Bidhan Chandra Krishi Viswavidyalaya (22°5'N latitude and 89°E longitude with an altitude of 9.75 meters above the mean sea level), Kalyani, Nadia, West Bengal with nine treatments [T_1: Unweeded check, T_2: Hand Weeding (HW) at 20 DAP, T_3: T_2 + mulching, T_4: Metribuzin @0.60 kg a.i. ha^{-1}, T_5: Quizalfop ethyl @1kg a.i. ha^{-1}, T_6: Pendimethalin @1kg a.i. ha^{-1}, T_7: T_4 + mulching, T_8: T_5 + mulching, T_9: T_6 + mulching] replicated thrice in randomized block design. The soil of the experimental field was typically Gangetic alluvium (Entisol) type with sandy clay loam in texture having pH of 6.55, total 0.055% N, 26.29kg ha^{-1} available P_2O_5 and 148.72kg ha^{-1} available K_2O. The climate of the experimental site was subtropical humid. Potato tubers of variety Kufri-Jyoti were planted after proper tuber treatment. Recommended dose of fertilizer was 180:130:130kg N: P_2O_5: K_2O ha^{-1} respectively. Urea, SSP and MOP were used as the sources of N, P and K respectively. Excluding the weed management practices, all the recommended improved package of practices including the plant protection measures was followed as par stipulated schedule for raising the crop. Observations on density and dry weight of weed were taken at 30, 60 days after planting (DAP) and at harvest by placing a quadrat of 0.5m×0.5m randomly at five places in each plot. At maturity, potato tuber samples were collected from each plot, oven dried at 70°C to constant weight and ground to pass through a 0.5mm sieve for chemical analysis. The nitrogen (N) content was determined by the semi-micro Kjeldahl method [AOAC 1995, method No. Ba 4b-87(90)], after the plant tissues (0.2 g) were oxidized and decomposed by concentrate sulphuric acid (10ml) with digestion mixture (K_2SO_4: $CuSO_4$ = 5:1) heated at 400°C temperature for two and half hours. Phosphorus (P) and Potassium contents were determined by the Vanado-Molybdate yellow method and flame photometry (Jackson 1973) respectively. Data for each character were statistically analysed (Gomez & Gomez 1984). Benefit : cost ratio of each weed control treatment was worked out on the basis of value of variable inputs

used in the experiment and the value of yield gained.

Results and Discussion

The predominant weeds found in the experimental plots were grasses like, *Elusine indica*, *Dactyloctenium aegyptium* etc; sedges like, *Cyperus rotundus*, *Cyperus iria*, *Fimbristylis littoralis* etc. and broad leaf weeds like *Chenopodium album, Anagallis arvensis* etc.

Both the weed density and dry weight of weeds were significantly reduced in different treated plots as compared to unweeded check. As par the data depicted in Table 1 it is quite evident that the combined approach of weed management controls weeds in a more proficient comportment than that the chemical or manual approaches do. Hand weeding at 20 DAP along with mulching (T_3) caused maximum reduction in weed growth and this treatment illustrated no statistical difference with the application of Metribuzin @0.60kg a.i. ha^{-1} combined with mulching (T_7) and the combined application of Pendimethalin @1kg a.i. ha^{-1} and mulching (T_9) (Table 1). Similar findings were also recorded by Muhammad & Banaras (1993). Reduced weed growth under these treatments might be due to the better control of weeds through the integrated method of weed control. Analogous trend of result was documented in case of tuber yield of potato. The population of weeds was less in the plots where combined techniques of weed management were followed. As a result there was minimum crop weed competition which ultimately results better crop growth. Total yield could be considered to be the mirror of all the growth features. The maximum yield was recorded with the treatment T_3 which was again statistically at par with the treatment T_9 and T_7. These results corroborate the findings of Muhammad & Banaras (1993) Jaiswal & Lal (1996) and Nandal *et al.* (1999).

The maximum benefit: cost ratio *i.e.* 3.81 was achieved with the treatment T_3 (hand weeding + mulching). The treatment T_9 and T_8 also brought about a good B: C ratio of 3.59 and 3.61, respectively. Similar findings were documented by Singh & Lal (1994).

In case of nutrient uptake by potato, the highest values were recorded with the treatment T_9 and the lowest values were documented with unweeded check (T_1). But the treatment T_1 (unweeded check) depicted the maximum nutrient removal by the weeds where hand weeding at 20 DAP along with mulching caused the minimum nutrient mining by the weeds. These results validate the findings of Jaiswal (1994) Singh & Lal (1994), and Datta *et al*. (2000).

From the experiment, it is flawless to opine that the integrated approach of weed management is the best amongst all the treatments used in the field to control all kinds of weeds. Though the treatment T_3 *i.e.* hand weeding along with mulching chronicled the maximum economic benefit but sometimes labour paucity was there which limits this weed management practice. As the twin application of Metribuzin @0.60kg a.i. ha^{-1} and mulching (T_7) and the application of Pendimethalin @1kg a.i.

ha^{-1} combined with mulching (T_9) showed encouraging weed control *vis-à-vis* enhanced tuber yield of potato. So we can successfully replace the hand weeding practice when there was scarcity of labour.

Table 1.

Effects of treatments on total weed density, biomass, weed control efficiency, tuber yield and B:C ratio of potato (pooled data)

Treatment	Total weed density (No. m^{-2})			Total weed biomass (g m^{-2})			Weed control efficiency (%)			Tuber yield (t ha^{-1})	B:C ratio
	30 DAP	60 DAP	At harvest	30 DAP	60 DAP	At harvest	30 DAP	60 DAP	At harvest		
T_1	21.26	20.89	44.46	8.14	16.29	26.14	--	--	--	19.44	2.66
T_2	17.37	14.27	32.91	4.22	11.11	18.16	36.23	27.62	23.51	23.48	3.14
T_3	6.03	5.95	17.56	2.11	4.84	14.94	74.55	79.91	49.24	29.32	3.81
T_4	10.64	12.19	26.76	4.86	6.29	16.69	45.22	55.71	42.17	24.01	3.20
T_5	13.15	11.27	25.84	3.88	9.88	13.62	38.17	51.34	40.23	23.64	3.04
T_6	14.54	12.40	28.09	6.44	12.12	19.47	41.90	45.86	32.06	25.52	3.45
T_7	7.80	8.98	24.66	3.14	8.01	11.05	65.83	73.85	61.05	26.43	3.42
T_8	8.64	9.92	20.24	4.12	5.47	12.36	25.17	63.78	55.77	27.37	3.61
T_9	11.00	9.01	22.95	4.31	9.92	16.24	48.82	57.56	45.28	28.88	3.59
SEm (±)	0.97	1.21	2.07	0.98	1.89	1.62	--	--	--	0.89	--
CD (P=0.05)	3.01	3.63	6.01	2.65	5.23	4.69	--	--	--	2.79	--

DAP- Days after planting

Table 2.

Effects of treatments on nutrient uptake by potato and weed grown in potato field (pooled data)

Treatment	Nutrient uptake by potato (kg ha^{-1})			Nutrient uptake by Weeds (kg ha^{-1})		
	N	P	K	N	P	K
T_1	51.00	13.28	59.32	69.80	19.52	219.27
T_2	55.28	17.45	74.27	57.35	15.21	206.08
T_3	91.03	31.54	132.45	19.43	10.44	91.33
T_4	69.27	22.54	92.07	64.42	17.14	173.60
T_5	69.62	21.50	88.90	67.73	16.52	176.44
T_6	77.72	24.29	100.70	61.44	17.66	164.79
T_7	83.41	26.79	130.50	42.83	15.22	154.19
T_8	84.51	26.65	107.73	51.65	13.08	139.08
T_9	102.40	32.56	124.90	43.81	12.43	130.89
SEm (±)	1.72	1.78	2.61	1.89	1.19	1.81
CD (P=0.05%)	5.47	5.67	7.53	5.49	3.69	5.44

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