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Champak Kumar Kundu
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Madhab Kumar Datta
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Abisekh Labar
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Utpal Biswas
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Purnendu Sekhar Bera
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Arindam Kundu
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Kanu Murmu
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Correspondence
Madhab Kumar Datta
Department of Agronomy, Faculty of
Agriculture, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur, Nadia,
West Bengal, India

Bio-efficacy and phytotoxicity of 2, 4-D ethyl hexyl ester 60% EC in potato

Champak Kumar Kundu, Madhab Kumar Datta, Abisekh Labar, Utpal Biswas, Purnendu Sekhar Bera, Arindam Kundu and Kanu Murmu

Abstract

A field experiment was carried out at Regional Research Station, BCKV, Gayeshpur during *rabi* season of 2014 and 2015 to find out the bio-efficacy and phytotoxicity of 2, 4-D Ethyl Hexyl Ester 60% EC in cultivated variety Kufri Jyoti of Potato. There were eight treatments i.e. weed management practices in the experiment and tested under Randomized Block Design with three replications. 2, 4 D EE 38% EC and different doses of 2,4-D Ethyl Hexyl Ester 60% EC as post emergence spray; Metribuzin 70% WP as pre emergence spray and hand weeding were considered in the treatments. Twice hand weeding at 20 and 40 DAP recorded the highest weed control efficiency which is followed by 2, 4-D EHE 60% EC @ 0.576 a.i. kg/ha and 2, 4-D EHE 60% EC @ 0.432 a.i. kg/ha. No phytotoxicity effect was observed in potato by any of the treatments. The highest potato yield (24.53 t ha⁻¹) was recorded in twice hand weeding which is statistically at par with 2,4-D EHE 60% EC @ 0.576 a.i. kg/ha (24.37 t ha⁻¹). From the present experiment it can be concluded that the application of 2, 4-D EHE 60% EC @ 0.576 a.i. kg/ha as post emergence spray in potato would be beneficial practice to the farmer of West Bengal.

Keywords: Potato, weed management, 2, 4-D, hand weeding, phytotoxicity

Introduction

As compared to all other field crops, potato is an important food and vegetable crop of the world which produces more weight and calories per unit area (Das, 1993) [4]. Since potato initially exhibits slow emergence and growth, occupies wider row spacing and prefers frequent irrigations, luxuriant growth of weeds can be found, which offer severe crop-weed competition. According to several research workers, potato tuber yield may reduce by 80%, depending upon the severity of weeds (Lal 1998, Ciuberkis *et al.*, 2007, Kumar *et al.*, 2009) [10, 2, 8]. Even if 10 % potato yield loss is considered due to weeds in potato a sum of about Rs. 40 million production loss can be estimated (CPRI, 2013) [3]. According to Khurana *et al.*, 1993 [7]; manual weeding is quite effective but it is time consuming, uneconomic, tedious and may cause root injury and disturb root system because of shallow root system of potato. Under such circumstances, chemical weed control may be helpful (Kumar *et al.*, 2009) [8]. Since 1946, 2, 4-dichloro phenoxy acetic acid, or 2, 4-D in various formulations has gained attention in suppressing weeds in various crops, particularly the cereal grains. Potatoes are reported as intermediate in their resistance to 2, 4-D. Ennis *et al.*, 1946 [5] studied the effects of several growth regulating compounds on Irish potatoes, and found that application of 2,4-D had no adverse effect on Irish potatoes. They proposed the use of 2, 4-D to control weeds in potato crops. Here, an experiment have been designed to explore the bio efficacy and phytotoxicity effect of different doses of 2,4-D Ethyl Hexyl Ester 60% EC in potato. Other than 2,4-D Ethyl Hexyl Ester 60% EC, the experiment also comprised hand weeding, 2,4 D Ethyl Ester 38% EC and a popular potato herbicide, Metribuzin 70% WP in the treatments.

Materials and Methods

A field experiment was conducted in New Alluvial Zone (NAZ) at Regional Research Station of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia (28° 5.3' N, 83° 5.3' E and 9.75 m altitude) during *rabi* season of 2014 and 2015. The experiment was laid out in randomized block design (RBD), replicated thrice with eight treatments [2,4-D Ethyl Hexyl Ester 60% EC @ 0.144 kg a.i. ha⁻¹, 2,4-D Ethyl Hexyl Ester 60% EC @ 0.288 kg a.i. ha⁻¹, 2,4-D Ethyl Hexyl Ester 60% EC @ 0.432 kg a.i. ha⁻¹, 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹, 2,4-D Ethyl Ester 60% EC @ 0.45 kg a.i. ha⁻¹, Metribuzin 70% WP @ 0.50 kg a.i. ha⁻¹, Twice hand weeding at 20 DAP and 40 DAP, Unweeded control] in 5.0 x 4.0 m size plots.

Seed tubers of variety Kufri Jyoti were sown at 20 q ha⁻¹ rate with a row spacing of 20 cm in the last week of November and harvested 105 days later. All other standard agronomic practices including plant protection measures recommended for potato were followed. Herbicides were applied using 500 liters of water ha⁻¹ with a flat fan nozzle attached in a high volume Knapsack sprayer as per schedule. Observations on weed density, weed dry weight and tuber yield were recorded

and analyzed using the analysis of variance technique. Observations on plant phytotoxicity were recorded on 7th, 14th and 21th days after spraying of herbicides (DASH) using 0 to 10 scale (0 indicates no adverse effect of herbicides on the crop, and 10 indicates 100% adverse effect of herbicides on the crop). Weed control efficiency (Mani *et al.*, 1973) [11] and weed index (Gill, G.S. and Vijayakumar, 1969) [6] was calculated by using the following formula:

$$\text{Weed control efficiency (\%)} = \frac{\text{Dry weight of weeds in unweeded control} - \text{Dry weight weeds in treatment plot}}{\text{Dry weight of weeds in unweeded control}} \times 100$$

$$\text{Index (WI)} = \frac{\text{Yield of hand weeded plot} - \text{Yield of treated plot}}{\text{Yield of hand weeded plot}} \times 100$$

Results and discussion

Weed flora

The dominant weed flora in the potato field consisted of i) Grasses: *Dactyloctenium aegyptium*, *Eleusine indica*, *Cynodon dactylon* ii) Sedges: *Cyperus rotundus* iii) Broad Leaves: *Anagallis arvensis*, *Chenopodium album*, *Fumaria parviflora* etc. Similar results were found by Kumar *et al.*, 2009 [8]; Sharma *et al.*, 2004 [12]; Kour *et al.*, 2014 [9];

Effects on weeds

At 60 DAP unweeded control treatment plots recorded the highest density for grasses, sedges and broad leaf weeds (Table 1). Density was lowest for all types of weeds in twice hand weeding at 20 DAP and 40 DAP which is closely followed by Metribuzin 70% WP @ 0.5 kg a.i. ha⁻¹ (grasses - 9.02 m⁻², sedges - 27.61 m⁻²) and 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ (grasses - 9.71 m⁻², sedges - 28.53 m⁻²) in case of grasses and sedges. The lower doses of 2, 4-D Ethyl Hexyl Ester 60% EC left a lesser impact on the

suppression of grasses and sedges. Among the herbicides 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ (broad leaves - 8.43 m⁻²) followed by 2,4-D Ethyl Hexyl Ester 60% EC @ 0.432 kg a.i. ha⁻¹ (broad leaves - 10.21 m⁻²) recorded the lowest broad leaf weed density which were statistically at par with twice hand weeding at 20 DAS and 40 DAP. These observations corroborate the findings obtained by Newdick *et al.*, 2009.

Twice hand weedings at 20 DAP and 40 DAP resulted in the lowest dry weight of weeds (22.26 g m⁻²). Highest total dry weight of weeds (80.39 g m⁻²) was found in unweeded control at 60 DAP as there was no weed management practices involved which is consistent with the observations of Kour *et al.*, 2014 [9]. Among the chemicals 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ (24.02 g m⁻²) recorded the lowest total dry weight which was followed by 2,4-D Ethyl Hexyl Ester 60% EC @ 0.432 kg a.i. ha⁻¹ (26.70 g m⁻²). Similar result was obtained by Bandyopadhyay *et al.*, 2017 [11]; when 2,4-D Ethyl Hexyl Ester 60% EC was tested in wheat.

Table 1: Effect of different weed management treatments on weed density, total dry weight of weeds, weed control efficiency, tuber yield and weed index of potato (Two years pooled data)

Treatment	Weed density (Number m ⁻²) at 60 DAP			Total dry weight of weeds (g m ⁻²) at 60 DAP	Weed Control Efficiency (%) at 60 DAP	Tuber Yield (t ha ⁻¹)	Weed Index (%)
	Grass	Sedge	Broad Leaf				
Post emergence application of 2,4-D EHE 60% EC @ 0.144 kg a.i. ha ⁻¹	16.85	36.42	16.61	36.02	55.20	20.55	16.12
Post emergence application of 2,4-D EHE 60% EC @ 0.288 kg a.i. ha ⁻¹	13.11	34.14	13.01	31.33	61.02	22.80	6.94
Post emergence application of 2,4-D EHE 60% EC @ 0.432 kg a.i. ha ⁻¹	11.34	30.99	10.21	26.70	66.79	23.75	3.06
Post emergence application of 2,4-D EHE 60% EC @ 0.576 kg a.i. ha ⁻¹	9.71	28.53	8.43	24.02	70.12	24.37	0.61
Post emergence application of 2,4 D EE 38% EC @ 0.45 kg a.i. ha ⁻¹	12.55	35.14	12.71	29.55	63.24	23.00	6.12
Pre emergence application of Metribuzin 70% WP @ 0.5 kg a.i. ha ⁻¹	9.02	27.61	12.02	28.88	64.07	23.05	5.92
Hand weeding twice at 20 and 40 DAP	8.42	24.36	9.03	22.26	72.31	24.53	-
Unweeded control	32.53	68.33	32.50	80.39	-	11.57	52.79
S. Em (+)	1.38	1.89	2.04	1.95	-	0.21	-
C.D. (5%)	4.20	5.74	6.21	5.92	-	0.64	-

Weed control efficiency

2,4-D Ethyl Hexyl Ester 60% EC @ 0.144 kg a.i. ha⁻¹ (55.20 %) followed by 2,4-D Ethyl Hexyl Ester 60% EC @ 0.288 kg a.i. ha⁻¹ (61.02 %) resulted the lowest weed control efficiency. From the result, it appeared that post emergence application of 2,4-D Ethyl Hexyl Ester 60% EC at lower doses was unable to control the weeds during the early growth stages of jute. However, twice hand weeding at 20 DAP and 40 DAP

noted the highest weed control efficiency (72.31 %) followed by 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ (70.12 %) and 2,4-D Ethyl Hexyl Ester 60% EC @ 0.432 kg a.i. ha⁻¹ (66.79%).

Phytotoxicity

The observations taken in the experimental field on the basis of phytotoxicity rating scale (PRS) was prepared by visual

scoring scale of 0-10 indicated there was no phytotoxic symptom as epinasty/hyponasty, leaf yellowing, necrosis, stunting growth, wilting. All the crop plants looked healthy during experimental time in the experimental field. This result depicts that even the higher doses 2,4-D Ethyl Hexyl Ester 60% EC have no phytotoxicity effect on potato crop rather increases the growth by reducing weed competition.

Tuber yield

Twice hand weeding at 20 DAP and 40 DAP produced highest tuber yield (24.53 t ha⁻¹) and was statistically at par with 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ which recorded tuber yield of 24.37 t ha⁻¹. Among the other treatments 2,4-D Ethyl Hexyl Ester 60% EC @ 0.432 kg a.i. ha⁻¹ (23.75 t ha⁻¹) and Metribuzin 70% WP @ 0.5 kg a.i. ha⁻¹ (23.05 t ha⁻¹) produced higher yield where as lowest yield was found in unweeded control (11.57 t ha⁻¹).

Weed Index

The lowest weed index among the herbicides was recorded in 2, 4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ (0.61 %) DAP which favoured higher tuber yield of potato. Unweeded (52.79 %) control and lower doses of 2,4-D Ethyl Hexyl Ester 60% EC recorded higher weed index and produced lower yield.

Conclusion

Considering the weed control efficiency and tuber yield of the treatment plots in this experiment, it can be concluded that chemical method of weed management through 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ can replace twice hand weeding at 20 and 40 DAP. Since 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ gave the yield statistically at par with twice hand weeding and less labour intensive, therefore, it can further be concluded that 2,4-D Ethyl Hexyl Ester 60% EC @ 0.576 kg a.i. ha⁻¹ can be recommended to the potato farmer of West Bengal.

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