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# EVALUATING THE MANUAL AND CHEMICAL METHODS FOR WEED CONTROL IN POTATO (*SOLANUM TUBEROSUM* L.) UNDER *TARAI* CONDITIONS OF UTTARAKHAND

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**ABSTRACT**
In order to evaluate the manual and chemical methods for weed control in potato crop, a field experiment was conducted during the *rabi* season of 2014-15 at Vegetable Research Centre, G.B. Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand. The experimental field was laid out in Randomized Block Design with 3 replications and 7 treatments out of which treatment $T_2$ (weed free) recorded the minimum fresh weight (2.76g and 4.37g) and dry weight (0.23g and 0.87g) of weeds at both, 30 and 45 days after planting (DAP) respectively, along with maximum potato tuber yield (356.48 q/ha) followed by treatment $T_6$ metribuzin @ 0.75 kg a.i./ha as pre emergence (308.95 q/ha). However, the results indicated that application of metribuzin @ 0.75 kg a.i./ha as pre emergence *i.e.,* treatment $T_6$ had more efficacy to weed control whereas, total number of weeds 5.33 and 66.67 were minimum under treatment weed free during both growth stages *i.e.,* 30 and 45 DAP respectively.

## INTRODUCTION

Potato (*Solanum tuberosum* L.) is the most important non-cereal food crop of the world and widely cultivated after wheat, rice and maize. It is used as vegetable, stock feed and in industries for manufacturing alcoholic beverages, starch and other processed products. It is an important temperate crop which has been adopted well for cultivation under sub-tropical conditions. In India, potato is being cultivated on 19.73 lakh hectare area with a total annual production of 415.55 lakh MT. It has 21.0 per cent share of total vegetable production in India with a productivity of 23.12 t/ha (Anonymous, 2015). About 90% of the total potato area is located in sub-tropical plains, 6% in the hills and 4% in the plateau region of peninsular region (Chadha, 2009). Potato is an important crop of Uttarakhand state as it is a good source of income and employment generation. In Uttarakhand, it is cultivated on 24.71 thousand hectare area with production of 409.62 thousand tonnes and a productivity of 16.58 tonnes/ha (Anonymous, 2015). Of the several bottlenecks in potato production, weeds often pose a serious problem. They not only compete with the crop plants for nutrients, water, space and sunlight but also serve as alternate host of several insect pest and diseases. If early control measures are not taken, they completely smother the potato plants in early stages of growth resulting in lower yields (Lal, 1993).

Dua (2000) reported that among different weed control treatments, significantly lowest dry matter yield of dicot, monocot and total weeds were obtained with treatment of herbicide "Alachlor". Nandekar (2005) concluded that all weed control methods reduced the weed dry weight significantly at 30 days. Pandey *et al.* (2008) suggested that if metribuzin @ 0.7 kg/ha or oxyfluorfen @ 0.2 kg/ha applied to potato in potato-wheat sequence controls not only the weeds in potato but also in wheat through residual effect. Similarly, direct as well as residual effect in controlling weeds was found in potato-black gram sequence when metribuzin @ 0.7 kg/ha and methabenzthiazuron @ 1.0 kg/ha were applied to potato crop. Chandrakar *et al.* (2013) found that the herbicide metribuzin (500 g a.i./ha as pre emergence) proved best among other weed management practices and recorded minimum total weed density and total weed dry weight at all stages and the maximum total tuber yield of potato crop. Yadav *et al.* (2015) evaluated comparative efficacy of chemical and non-chemical methods of weed management in potato and found that the application of metribuzin @ 1.0 kg a.i./ha as pre emergence gave the highest reduction in total weed density and weed dry matter accumulation as compared to other herbicides.

Keeping this in view, the present experiment was conducted with the objective to evaluate the effect of different manual and chemical weed management practices on weed incidence and production behavior of potato.

## MATERIALS AND METHODS

The present field work was carried out during the *rabi* season 2014-15 at Vegetable Research Centre, G.B. Pant University

of Agriculture and Technology, Pantnagar, District- Udham Singh Nagar, Uttarakhand. The experiment was conducted under irrigated condition and laid out in randomized block design. The experiment consisted of three replication with seven treatments *viz.*, $T_1$ (weedy check), $T_2$ (weed free), $T_3$ (hand weeding at 30 DAP), $T_4$ (hand weeding at 40 DAP), $T_5$ (hand weeding at 50 DAP), $T_6$ (herbicide metribuzin @ 0.75 kg a.i. / ha pre emergence) and $T_7$ (herbicide metribuzin @ 0.75 kg a.i. / ha post emergence). The NPK were applied as per the recommended dose *i.e.*, 160:100:120 kg N, $P_2O_5$ and $K_2O$/ ha, respectively. Half dose of nitrogen and full dose of phosphorus and potassium were applied at the time of planting and remaining half dose of nitrogen was top dressed at the time of earthing-up *i.e.*, 30 days after planting (DAP). For treatment $T_2$ (weed free) hand weeding was done on weekly basis till the de-haulming stage to keep the plot weed free. Well-sprouted seed tubers of potato cv. Kufri Surya of 40-50 g were planted at 60 x 20 cm spacing during fourth week of October. The potato crop was de-haulmed at 82 days after planting. Other agronomic practices were followed as per recommendations for potato cultivation. The data was subjected to analysis of variance (ANOVA) using method given by Panse and Sukhatme (1987).

Number of weeds (monocot and dicot) were counted at 30 and 45 DAP from each plot by randomly throwing a quadrate of $50 \times 50$ cm$^2$ and weeds which came inside it were collected as sample and expressed in 1m$^2$. The fresh weed samples weighed with the help of electronic balance and average weight was expressed in grams. The weed samples were sun dried for 7-8 hours/ day for 2-3 consecutive days then dried in oven at about 55-60 $^0$C, till the samples attained a constant weight. After drying, the samples were weighed and dry weight was recorded in grams per m$^2$. The total tuber yield was calculated on the basis of tuber yield per plot and expressed in q/ha.

## RESULTS AND DISCUSSION

### Growth parameters

The number of monocot weeds (Table 1) at 30 and 45 DAP was affected significantly with the different treatments. The maximum number at 30 DAP was recorded in treatment $T_5$ (hand weeding at 50 DAP) which was at par with treatment $T_7$ (metribuzin @ 0.75 kg a.i./ ha post emergence), $T_3$ (hand weeding at 30 DAP) and $T_1$ (weedy check) whereas, the minimum number was found in $T_2$ (weed free) which was at par with treatment $T_6$ (metribuzin @ 0.75 kg a.i./ ha pre emergence). At 45 DAP, the maximum number of monocot weeds was recorded in treatment $T_5$ (hand weeding at 50 DAP) which was at par with treatment $T_4$ (hand weeding at 40 DAP), $T_1$ (weedy check) and $T_3$ (hand weeding at 30 DAP) whereas, the minimum number was found in $T_2$ (weed free) which was at par with treatment $T_7$ (metribuzin @ 0.75 kg a.i./ ha post emergence), and $T_6$ (metribuzin @ 0.75 kg a.i./ ha pre emergence). The critical observation of the data showed that treatment $T_2$ (weed free) resulted lowest number of monocot weeds per m$^2$ which is because of the regular weed free condition maintained. Similar findings were also obtained by Channappagoudar *et al*. (2007) and Mukhopadhyay *et al*. (2002).

The effect of different treatments on number of dicot weeds per m$^2$ (Table 1) at 30 and 45 DAP was found non-significant. At 30 DAP, the maximum number was recorded under treatment $T_1$ (weedy check) whereas, the minimum number was found in treatment $T_2$ (weed free) and $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence), while at 45 DAP, the maximum number was recorded in treatment $T_5$ (hand weeding at 50 DAP) whereas, the minimum number was obtained in treatment $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence) and $T_7$ (metribuzin @ 0.75 kg a.i./ha post emergence). The critical observation of the data revealed that treatment $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence) recorded significantly lowest number of dicot weeds per m$^2$ which is due to the effect of metribuzin which is readily absorbed by the roots of weed plants, once they emerge, and kills them in 2-5 days. Similar findings were obtained by Channappagoudar *et al*. (2007) who reported that among different weedicides metribuzin @0.75-1.00 kg ai/ha found more efficient in controlling dicot weeds than other herbicides.

The total number of weeds (Table 1) at 30 and 45 DAP was also found to be significantly affected with different treatments. At 30 DAP, the total number of weeds was recorded maximum in treatment $T_5$ (hand weeding at 50 DAP) which was statistically at par with treatment $T_7$ (metribuzin @ 0.75 kg a.i./ha post emergence), $T_3$ (hand weeding at 30 DAP) and $T_1$ (weedy check) whereas, the minimum was observed in $T_2$ (weed free) which was statistically at par with treatment $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence). At 45 DAP, the highest value for total number of weeds was observed in treatment $T_5$ (hand weeding at 50 DAP) which was statistically at par with treatment $T_4$ (hand weeding at 40 DAP), $T_1$ (weedy check) and $T_3$ (hand weeding at 30 DAP) whereas, the lowest was observed in treatment $T_2$ (weed free) which was statistically at par with $T_7$ (metribuzin @ 0.75 kg a.i./ha post emergence) and $T_6$

**Table 1: Effect of weed management on number of monocot, dicot and total weeds**

| Treatments | Number of monocot weeds/ m$^2$ | | Number of dicot weeds/ m$^2$ | | Total number of weeds/ m$^2$ | |
|---|---|---|---|---|---|---|
| | 30 DAP | 45 DAP | 30 DAP | 45 DAP | 30 DAP | 45 DAP |
| $T_1$ : Weedy check | 10.33 (107.93) | 15.44 (240.00) | 3.57 (11.98) | 5.33 (30.68) | 10.92 (119.91) | 16.40 (270.68) |
| $T_2$ : Weed free | 2.49 (5.33) | 7.20 (53.33) | 1.00 (0.00) | 3.78 (13.33) | 2.49 (5.33) | 8.09 (66.67) |
| $T_3$ : Hand weeding at 30 DAP | 10.98 (122.96) | 14.34 (217.35) | 2.28 (5.31) | 4.96 (24.01) | 11.21 (128.27) | 15.15 (241.36) |
| $T_4$ : Hand weeding at 40 DAP | 9.09 (82.65) | 15.74 (249.32) | 2.28 (5.31) | 3.09 (17.31) | 9.41 (87.96) | 16.34 (266.64) |
| $T_5$ : Hand weeding at 50 DAP | 12.53 (157.35) | 16.66 (286.67) | 2.49 (5.31) | 5.57 (41.33) | 12.74 (162.65) | 18.02 (327.99) |
| $T_6$ : Metribuzin @ 0.75 kg a.i./ha pre emergence | 2.74 (6.64) | 11.34 (127.99) | 1.00 (0.00) | 1.00 (0.00) | 2.74 (6.64) | 11.34 (127.99) |
| $T_7$ : Metribuzin @ 0.75 kg a.i./ha post emergence | 11.56 (137.31) | 10.07 (101.33) | 2.45 (6.64) | 1.00 (0.00) | 11.81 (143.95) | 10.07 (101.33) |
| S.Em. ± | 0.89 | 1.63 | 0.53 | 1.37 | 0.87 | 1.41 |
| C.D. (0.05) | 2.73 | 5.01 | NS | NS | 2.67 | 4.35 |

Original values are in parenthesis and figures outside the parenthesis are transformed to $\sqrt{n+1}$

**Table 2: Effect of weed management on fresh weight, dry weight of weeds and tuber yield of potato**

| Treatments | Fresh weight of weeds ($g/m^2$) | | Dry weight of weeds ($g/m^2$) | | Total yield of tubers (q/ha) |
|---|---|---|---|---|---|
| | 30 DAP | 45 DAP | 30 DAP | 45 DAP | |
| $T_1$ : Weedy check | 15.89 (267.28) | 34.32 (1237.35) | 5.80 (33.02) | 12.27 (154.94) | 264.35 |
| $T_2$ : Weed free | 1.91 (2.76) | 2.28 (4.37) | 1.11 (0.23) | 1.36 (0.87) | 356.48 |
| $T_3$ : Hand weeding at 30 DAP | 12.36 (162.65) | 5.04 (27.47) | 4.15 (17.28) | 2.55 (6.17) | 300.62 |
| $T_4$ : Hand weeding at 40 DAP | 11.62 (139.81) | 7.53 (56.48) | 3.69 (13.27) | 3.42 (10.80) | 273.77 |
| $T_5$ : Hand weeding at 50 DAP | 18.04 (325.00) | 27.66 (894.75) | 5.77 (32.41) | 9.52 (100.62) | 270.37 |
| $T_6$ : Metribuzin @ 0.75 kg a.i./ha pre emergence | 4.82 (38.58) | 9.92 (101.54) | 2.72 (11.11) | 4.71 (21.91) | 308.95 |
| $T_7$ : Metribuzin @ 0.75 kg a.i./ha post emergence | 14.84 (220.06) | 7.09 (88.27) | 4.45 (18.83) | 4.41 (35.80) | 304.17 |
| S.Em. ± | 1.66 | 4.36 | 0.65 | 1.69 | 13.02 |
| C.D. (0.05) | 5.11 | 13.42 | 1.99 | 5.19 | 40.10 |

Original values are in parenthesis and figures outside the parenthesis are transformed to $\sqrt{n+1}$

(metribuzin @ 0.75 kg a.i./ha pre emergence). The total number of weeds per $m^2$ was significantly maximum in treatment $T_5$ (hand weeding at 50 DAP) because till 50 DAP treatment $T_5$ served same as $T_1$ (weedy check) as no weeding was performed there whereas the lowest total number of weeds observed in treatment $T_2$ (weed free) because of weekly hand weeding practiced under this treatment. Similar findings were obtained by Gugala and Zarzecka (2013) and Karimmojeni *et al*. (2014) who reported reduction in weed number by different weed management practices over weedy check. Yadav *et al*. (2015) reported that metribuzin @ 1kg a.i./ha as pre emergence caused the highest reduction in total weed density as compared to other herbicides.

The data on fresh and dry weight of weeds (Table 2) at 30 DAP and 45 DAP was also found significantly affected with the different treatments. The maximum fresh weight of weeds at 30 DAP was observed in $T_5$ (hand weeding at 50 DAP), whereas the minimum was recorded in treatment $T_2$ (weed free) which was statistically at par with $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence). At 45 DAP, the highest fresh weight of weeds was observed under treatment $T_1$ (weedy check), whereas the minimum was observed in $T_2$ (weed free) which was found statistically at par with $T_3$ (hand weeding at 30 DAP), $T_7$ (metribuzin @ 0.75 kg a.i./ha post emergence), $T_4$ (hand weeding at 40 DAP) and $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence).

The highest dry weight at 30 DAP was observed in treatment $T_1$ (weedy check), whereas the minimum was recorded in treatment $T_2$ (weed free) which was statistically at par with treatment $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence). At 45 DAP, the maximum dry weight of weeds was observed in treatment $T_1$ (weedy check), whereas, the minimum dry weight of weeds was observed in treatment $T_2$ (weed free) which was statistically at par with treatment $T_3$ (hand weeding at 30 DAP), $T_4$ (hand weeding at 40 DAP), $T_7$ (metribuzin @ 0.75 kg a.i./ha post emergence), and $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence).

Lowest fresh weight and dry weight of weed was recorded in weed free treatment because of weed free condition maintained under this treatment. Similar findings were reported by Yadav *et al*. (2015), Gugala and Zarzecka (2013), Karimmojeni *et al*. (2014), Chnnappagoudar *et al*. (2013) and Chaudhari *et al*. (2016). Channappagoudar *et al*. (2007) reported that among the weedicides metribuzin (0.75-1.0 kg a.i./ha) recorded the lowest weed biomass (14.08 to 16.1 $g/m^2$).

**Yield Parameter**

The maximum total yield (Table 2) of tubers (356.48 q/ha) was obtained under treatment $T_2$ (weed free) which was found significantly superior over (308.95 q/ha) of $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence) whereas, the lowest yield was recorded under treatment $T_1$ (weedy check) which was statistically at par with treatment $T_5$ (hand weeding at 50 DAP), $T_4$ (hand weeding at 40 DAP), $T_3$ (hand weeding at 30 DAP) and $T_7$ (metribuzin @ 0.75 kg a.i./ha post emergence). The increase in tuber yield in the treatment $T_2$ (weed free) might be due to less weed competition which leads to availability of nutrients, water, space, sunlight and proper aeration in root zone which resulted in better growth of photosynthetic organs, translocation of nutrients and photosynthates to developing plant parts. The results are in agreement with the findings of Arora *et al*. (2009), Singh *et al*. (2007), Nandekar (2005) and Mukhopadhyay (2002). Singh *et al*. (2015) reported that the wheat grain yield was negatively associated with total weed density, weeds biomass and therefore, weeds in weedy check reduced the grain yield of wheat.

The findings of present investigation revealed that the yield of potato tubers was significantly affected by the different weed control treatments. Among all treatments $T_2$ (weed free) was found superior in yield (356.48 q/ha) but to keep the weed free condition it required more number of hand weedings thereby increasing labour cost which increases its input cost. Hence, in terms of economics, treatment $T_6$ (metribuzin @ 0.75 kg a.i./ha pre emergence) was found superior and can be recommended. However, further more research needs to be done for commercial recommendation.

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