

Influence of different weed control strategies on growth, yield attributing characters, yield and quality parameters of Lentil (*Lens culinaris Medik.*)

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Abstract- A field experiment was conducted at the Crop Research Centre, School of Agriculture, Uttarakhand University, Dehradun, Uttarakhand to observe 'The efficiency of different weed management practices in Lentil' during the Rabi season of 2021-22. The experimental design used for the purpose was Randomised Block Design with 3 replications and 8 treatments. The treatments were as Control, 2 hand-weeding, Atrazine (Pre-emergence) @ 1kg a.i. /ha, Atrazine (PE) + 1 hand-weeding, Pendimethalin (post-emergence) @ 1kg a.i. /ha, Pendimethalin (PE) + 1 hand-weeding, Isoproturon (PoE) @ 1 kg a.i. /ha and Isoproturon (PoE) + 1hand-weeding. Out of all the treatments mentioned T6 which was Pendimethalin + one hand-weeding was found to be better in terms of growth as well as yield attributing characters such as plant height, number of branches, number of pods per plant, number of seeds per pod, seed yield per plant, grain yield, straw yield and biological yield however in terms of quality parameters such as dry matter accumulation in plants, seed index as well as protein content, the treatment T2 was observed to be superior than any other treatment. The least yield and product quality was found in T1 which is Control or Weedy Check.

Index Terms- Isoproturon, Pendimethaline, Control, Hand weeding, Yield

I. INTRODUCTION

Lentil (*Lens culinaris* Medik.) has been reported as one among the most primitive seasonal food/pulse crop which are being cultivated as a very crucial food source for more than 8,000 years (Dhuppar *et al.*, 2012). About 25% protein, 0.7% fat, 2.1% mineral, 0.7% fiber, and 60% of lentil's calories come from carbohydrates. It is also abundant in niacin, riboflavin, thymine, ascorbic acid, calcium, iron, phosphorus, potassium, zinc, and magnesium.

In India, lentil was grown for over 1.35 Million ha while production was 1.18 million tons (FAO, 2020). In India, the major producing states are Uttar Pradesh with 0.45 Million tonnes, Madhya Pradesh with 0.32 Million ton, West Bengal with 0.16 Million tonnes, and Bihar with 0.12 Million tonnes on about 11.15 thousand tonnes are produced in Uttarakhand. (Directorate of Economics and Statistics, 2020).

Weeds in lentils are a serious threat to productivity, reducing production by 70%. (Singh and Singh, 1985). Due to its tiny and thin canopy, the lentil is not highly competitive against weeds. The dominant weeds found in lentil crops are and *Chenopodium album* (6%), *Capsella bursa pastoris* (57.4%) and *Phalaris minor* (27.8 %). Other prevalent weeds involve (8.8 %), *Anagalis arvensis*, *Fumaria parviflora*, *Spergula arvensis*, and *Vicia sativa* (Bhattarai *et al.*, 2018).

II. MATERIALS AND METHODS:

A field experiment had been conducted during the Rabi season of 2021-22 at the Crop Research Centre of Uttarakhand University, Premnagar, Dehradun, Uttarakhand (30.33° N Latitude and 77.95° E Longitude). The maximum and minimum temperatures of the place is 27.65°C and 13.8°C respectively. The soil of the experimental site contained sand 53.40 %, silt 25.40% and clay 21.30%. The soil texture was Sandy loam having pH almost neutral which is 7.4 and organic carbon 0.83%. The available Nitrogen 297.8 kg/ha, available P 13.8 kg/ha and available K

was 237.5 kg/ha. The experimental design selected for this purpose was randomised block design using 3 replications and 8 treatments. The treatments applied were T1 as Control, T2 as Two hand-weeding, T3 as Atrazine @ 1kg a.i. per hectare (PE), T4 as Atrazine (PE)+ 1 hand-weeding, T5 as Pendimethalin @ 1kg a.i. per hectare (PoE), T6 as Pendimethalin (PE) + 1 hand-weeding, T7 as Isoproturon @ 1 kg a.i. per hectare (PoE) and T8 as Isoproturon (PoE)+ 1 hand-weeding.

The sowing had been done on 26th November, gap filling at 17th December and the harvesting had been done on 13th of April. Seed rate was 40 kg/ha and the recommended dose of fertilizer that is 20 kg/ha of N, 40 kg/ha of P and 20 kg/ha of S. The application of pre-emergence herbicide was done on 25th November. The post-emergence herbicide application was done at 45 days and 2 hand-weeding was performed at 30 and 60 DAS respectively. In treatments of herbicide + 1 hand-weeding was done at 45 DAS. The crop variety used was VL-Masoor 103.

III. RESULTS AND DISCUSSION:

Table: 4.14 Effect of various weed control methods on the height of plants at different stages of growth

| Treatments | Height of plants in (cm) | | |
|---|--------------------------|-------|-------|
| | 30 | 60 | 90 |
| T1 (CONTROL) | 4.90 | 13.89 | 24.20 |
| T2 (2 Hand weeding) | 6.50 | 17.10 | 28.48 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 5.76 | 17.25 | 27.57 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 5.81 | 17.00 | 27.98 |
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 5.86 | 16.56 | 27.52 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 6.23 | 17.40 | 28.25 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 6.40 | 13.62 | 23.09 |
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 6.30 | 13.14 | 23.62 |
| SEm± | 0.09 | 0.54 | 0.92 |
| CD (P≥0.05%) | 0.53 | 1.29 | 1.68 |

The plant height had been observed at 30, 60, and 90 days after sowing. At 30 DAS, the plant height in all the treatments was almost equal, still, the tallest plants were found in T2 (Two hand-weeding), followed by T7 (Isoproturon @ 1kg a.i./ha) and T8 (Isoproturon + One hand-weeding) as Isoproturon was not applied in the plots till then. T7 is statistically at par with T2 and T6 (Pendimethalin + One hand-weeding) is statistically at par to T8. The shortest height of plants had been observed in T1 which is Control. At 60 DAS, the maximum heights were attained by treatments of Pendimethalin+ One hand-weeding (T6), two hand-weeding (T2), Atrazine + One hand-weeding (T4). T4 is statistically at par to T2. The minimum heights were observed in T8 which is Isoproturon + One hand-weeding, T7 which is Isoproturon @ 1kg a.i./ha as well as Control (T1). Isoproturon initially affects the growth of the plants, as a result of which the plants show stunting after application of this chemical. At 90 DAS, the plant height was observed again and the tallest plants were found in T2 (2 hand-weeding), T6 (Pendimethalin + One hand-weeding) is at par to T2. T3 (Atrazine @ 1kg a.i per hectare) and T5 (Pendimethalin @ 1 kg a.i per hectare) are statistically at par to T4 (Atrazine + 1 hand-weeding). Lowest plant height was observed in Control.

Table: 4.15 Effect of various weed control methods on number of branches at various stages of growth

| Treatments | Number of branches day after sowing | | |
|---|-------------------------------------|------|------|
| | 30 | 60 | 90 |
| T1 (CONTROL) | 2.06 | 4.60 | 5.40 |
| T2 (2 Hand weeding) | 2.80 | 5.40 | 6.46 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 2.53 | 5.20 | 6.13 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 2.50 | 5.13 | 6.40 |
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 2.73 | 5.00 | 6.26 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 2.93 | 6.00 | 6.96 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 2.26 | 4.80 | 6.00 |

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| | | | |
|---|------|------|------|
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 2.40 | 5.10 | 6.06 |
| SEm± | 0.08 | 0.04 | 0.05 |
| CD (P≥0.05%) | 0.49 | 0.37 | 0.39 |

The branches number was observed at 30, 60 as well as 90 days from the sowing. At 30 DAS, the highest branching had been observed in T6 which is Pendimethalin + One hand-weeding followed by T2 which is Two hand-weeding. T2 is also observed to be significantly at par to T6 and the lowest branching is observed in T1 which was Control. At 60 DAS, the observation of branches number had been taken and the highest branching was found again in T6 (Pendimethalin + One hand-weeding) and T2 which is Two hand-weeding was observed to be at par statistically to the T6. The lowest branching had been found in T1 which is control. At 90 DAS, the number of branches is observed to be highest in T6. T2 as well as T4 was observed to be statistically at par with T6. Number of branches is some important criteria as in legumes like lentil and chickpea, more the number of branches more is the number of flowers followed by number of pods.

Coming to the plant attributes of growth, the height of plants and branches number were observed. The observation of height was taken at 30, 60, as well as 90 DAS as the plant height, shows a minimal or negligible increase after attaining the reproductive stage. The number of branches was observed at an interval of 30, 60, and 90 DAS. The period of vegetative growth gets extended when the climatic conditions are not favourable. In the parameters of vegetative growth (plant height, number of branches) the treatment T6 which is (Pendimethalin + One hand weeding) depicted the best results followed subsequently by T2 which is Two hand-weeding and T4 (Atrazine One hand-weeding). Herbicides application along with cultural practices enhanced the height of the plant as well as primary branches of plant, resulting into the increment of the plants' lateral growth (Erskine *et al.*, 2009).

Table: 4.16 Effect of various weed control methods on accumulation of dry matter at different stages of growth

| Treatments | Dry matter accumulation (g) | | |
|---|-----------------------------|------|-------|
| | 30 | 60 | 90 |
| T1 (CONTROL) | 0.85 | 4.47 | 16.41 |
| T2 (2 Hand weeding) | 0.96 | 6.85 | 20.42 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 0.78 | 5.76 | 17.66 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 0.90 | 6.55 | 19.97 |
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 0.81 | 6.23 | 17.87 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 0.99 | 6.98 | 20.65 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 0.85 | 5.24 | 17.12 |
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 0.89 | 5.55 | 17.12 |
| SEm± | 0.02 | 0.03 | 0.01 |
| CD (P≥0.05%) | 0.02 | 0.32 | 0.17 |

Plant dry matter accumulation is observed at 30, 60 and 90 DAS. It was observed highest in T2 which is a complete cultural practice-based treatment. In this treatment, the product obtained is free from any type of herbicide or chemical. Hence the dry matter accumulation was highest. Other treatments in which herbicides are used are affected by the side effects of the chemicals and hence the dry matter obtained was slightly low. Imtiaz *et al.* 2020 confirmed the fact that lentil due to its physiological characters is more sensitive to chemicals than any other cereal or legume crops.

Table: 4.18 Effect of various weed management practices on yield attributes of lentils

| Treatments | Number of pods per plant | Number of seeds per pod | Seed yield per plant |
|---|--------------------------|-------------------------|----------------------|
| T1 (CONTROL) | 15.60 | 1.30 | 27.83 |
| T2 (2 Hand weeding) | 29.00 | 2.12 | 41.80 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 21.66 | 1.94 | 31.56 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 27.66 | 1.94 | 32.56 |

| | | | |
|---|-------|------|-------|
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 23.09 | 1.96 | 34.63 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 32.06 | 2.19 | 44.73 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 19.06 | 1.94 | 28.93 |
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 20.40 | 1.96 | 30.26 |
| SEm ± | 1.84 | 0.02 | 3.25 |
| CD (P ≥0.05%) | 2.37 | 0.25 | 3.15 |

Table: 4.19 Effect of various weed control methods on yield of grain, yield of straw, total biological yield and harvest index

| Treatments | Grain yield (kg/ha) | Straw yield (kg/ha) | Biological yield (kg/ha) | Harvest index (%) |
|---|---------------------|---------------------|--------------------------|-------------------|
| T1 (CONTROL) | 284.69 | 1033.95 | 1318.64 | 21.50 |
| T2 (2 Hand weeding) | 439.88 | 1110.66 | 1550.55 | 21.87 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 292.98 | 1048.33 | 1340.31 | 21.78 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 314.24 | 1127.06 | 1441.31 | 21.79 |
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 309.77 | 1123.90 | 1433.67 | 21.60 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 443.49 | 1265.60 | 1709.09 | 25.94 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 292.25 | 1042.40 | 1323.88 | 21.67 |
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 292.33 | 1042.82 | 1330.54 | 21.72 |
| SEm ± | 18.67 | 22.73 | - | 0.02 |
| CD (P ≥0.05%) | 7.55 | 8.35 | - | 0.29 |

The study of reproductive parameters included the grain yield, pods per plant, harvest index and biological yield. All of the treatments' application created an impact over biological yield and grain yield remarkably over the control. The highest average biological yield and grain yield had been found in Pendimethalin + One hand weeding (T6) as well as two hand weeding (T2). This was confirmed by Gupta and Rao, 2013 that better the weed control better would be the yield contributing attributes like number of flowers, seed yield per plant, seed per pod, number of pods per plant, total biological yield, grain yield as well as straw yield.

Table: 4.20 Effect of various weed control methods on weight of 100 seeds.

| Treatments | Weight of 100 seeds (gm) |
|---|--------------------------|
| T1 (CONTROL) | 1.60 |
| T2 (2 Hand weeding) | 3.40 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 2.01 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 2.35 |
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 2.20 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 2.50 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 1.90 |
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 2.30 |
| SEm ± | 0.02 |
| CD (P ≥0.05%) | 0.24 |

The 100 seeds weight had been computed from each plot of the field to check the seed quality. The quality of the seeds obtained from the plot in which hand weeding was applied was the best. The weight of 100 seeds (seed index) was highest in the plot of Two hand-weeding. Herbicides may be effective in controlling the weed density/ population better but it also has an adverse effect on the quality of the produce. The product quality degrades as residues from herbicides/chemicals are present in it. Cereal crops are usually more tolerant to chemicals than those of legume crops. Lentil is very sensitive toward herbicide phytotoxicity as confirmed by Imtiaz *et al.* 2020 and Leoci and Ruberti 2020.

Table: 4.21 Effect of various weed management practices on protein content of the produce

| Treatments | Protein Content (%) |
|---|---------------------|
| T1 (CONTROL) | 23.32 |
| T2 (2 Hand weeding) | 25.02 |
| T3 (Atrazine (PE), ATRATEX 50% WP @ 1kg a.i. per hectare) | 24.01 |
| T4 (Atrazine (PE) + 1 Hand weeding) | 24.51 |
| T5 (Pendimethalin PoE, PENDANT 30% EC @ 1kg a.i. per hectare) | 24.06 |
| T6 (Pendimethalin (PE) + 1 hand weeding) | 24.98 |
| T7 (Isoproturon (PoE) SHIVRON 75% WP @ 1kg a.i. per hectare) | 23.91 |
| T8 (Isoproturon (PoE) + 1 Hand weeding) | 24.48 |
| SEm ± | 0.09 |
| CD (P ≥0.05%) | 0.27 |

Herbicides have a tendency to degrade the nutritional quality of the grains, mainly the content of protein because of the chemical composition which prevents accumulation of Nitrogen in it. There are differences in the protein content of different treatments. The T2 and T6 which are two hand-weeding and Pendimethalin + One hand- weeding have shown highest protein content whereas the lowest protein content was found in Control which is T1. The other treatments which were using chemicals solely were also observed to have comparatively lower protein content as confirmed by Kumar and Nandan, 2014.

IV. CONCLUSION:

The outcome of the observation depicts that in terms of vegetative growth, yield and other yield attributing characters, the combination of suitable herbicide and cultural practice which is Pendimethalin + one hand-weeding (T6) is best suited. The outcomes from the treatment of Two hand-weeding (T2) was also observed to be at par statistically to T6. However, in terms of attributes depicting the quality of the produce such as dry matter accumulation, seed index (weight of 100 seeds) as well as Protein content of the produce the treatment of Two hand-weeding (T2) was observed to be the superior. Pendimethalin +one hand-weeding was observed to be the second best in terms of quality as herbicides have a tendency to hamper the quality of the produce. The most suitable weed control practices observed in the experiment were Pendimethalin + one hand-weeding (T6) as well as Two hand-weeding (T2).

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