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Effect of Weed Management Practices on Growth, Yield of Vegetable Cowpea (*Vigna unguiculata* (L.) Walp.) cv. Kashi Kanchan

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation contains seven different treatments *viz.*, weedy check (control), weed free check (3 hand weeding) (first hand weeding at 25 DAS), pre-emergence application of Pendimethalin @ 6ml/L, pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding, pre- emergence application of Pendimethalin @ 6ml/L + post emergence @ 40-50 g/ha at 25 DAS, post-emergence application of Metribuzin @ 525g/ha at 25DAS and post-emergence spray of Imazethapyr @ 100 g ai/ha at 25 DAS replicated thrice. The cowpea variety 'Kashi Kanchan' was

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used in experiment. Results of the experiment revealed that though, the weed free check (T_2) recorded zero weed population and slightly higher values of growth and yield parameters but among tested treatments, pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding (T_4) and pre-emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS(T_5) significantly reduced weed number (48.12 and 52.18/m^2) and produced significantly highest plant height (47.30 and 45.98 cm), pod length (21.64 and 20.86 cm), number of pods/plant (35.94 and 34.18), average pod weight(11.18 and 11.06 g), green pod weight/plant (367.84 and 348.63g), green pod weight/plot (11.24 and 10.54 kg) and green pod yield per hectare(118.96 and 111.55q). However, these three treatments (T_2, T_4 and T_5) were statistically at par with each other in terms of growth and yield parameters.Hence, these two weed management practices (T_4 and T_5) may serve as alternative of manual weeding and may be recommended for farmers of the central plain zone of Uttar Pradesh for higher returns from vegetable cowpea crop.

Keywords: Pre-emergence; quizolofop ethyl; weed-free check; hand weeding.

1. INTRODUCTION

"The history of cowpea dates to ancient West African cereal farming, 5 to 6 thousand years ago, where it was closely associated with the cultivation of sorghum and pearl millet. Worldwide cowpea production has increased dramatically in the last 25 years. Cowpea (*Vigna unguiculata* L. Walp.), a legume, is one of the most ancient crops known to man. It belongs to family Fabaceae and sub family Papilionaceae . Its primary centre of origin is in Africa. It is widely adopted and grown all over the world" (Shivnanda, 2005).

"India is next only to the China in area and production of vegetables NHB 2021-22. Immature cowpea green pods are commonly referred to as southern pea, black eye pea, crowder pea, lobia, niebe, caupi or frijole. The name "cowpea" probably derives from when it was an important livestock feed for cows in the United States. Among the different pulses grown in the world, cowpea is grown in 14.5 million ha with production of 6.5 million metric tonnes and the productivity of 387 kg per ha" (www.cowpea.org). "This crop can be grown in kharif and summer season in North India, while in South India it is grown throughout the year. Cowpea is grown in small scale throughout the country for long green pods as a vegetable, seeds as pulses and foliage as fodder for milch animal. In India, the cowpea is grown in an area of about 3.9 million ha with a production of 2.2 million tonnes having a productivity of 600-750 kg seed per ha" (Shivnanda, 2005).

"Cowpea is commonly cultivated as a nutritious and highly palatable food source in Asia, and throughout the tropics and subtropics. Green pod of cowpea contains 85 g moisture, 3.0 g protein, 1.0 g minerals, 2.0 g fiber, 8.0 g carbohydrates, 72 mg calcium, 59 mg phosphorus, 2.0 mg iron, 0.09 mg riboflavin and 0.07 mg thiamin per 100 g of edible portion" [1].

"Cowpea competes poorly with weeds in the growing stage. This is made under irrigation where adequate moisture supply encourages the rapid growth of weeds. Traditional hoe-weeding is expensive, labour intensive, strenuous and may cause mechanical damage to the crop, and for this reason it is not recommended once the plants have spread out in the rows, as it may cause injury to the growing branches and roots" (Shivnanda, 2005).

"Weeds emerge fast and grow rapidly competing with the crop severally for growth and pod period. Weeds not only compete with crop plants for nutrients, soil moisture, space and sunlight but also serve as an alternative host for several insect pest and diseases. So, control of weeds in the initial and pod stages appears imperative as it plays an important role in maximizing the cowpea production. Thus, to enhance crop yield and its effect on soil fertility, the control of weeds in irrigated crop is very important. The conventional method of weeding such as hoeing, hand- weeding and harrowing is expensive and labour is not available during peak workload" (Khan *et al.*, 2000). Therefore, the use of herbicides in cowpea to control weeds appears to be useful [2]. In general "herbicides are effective only against few weed species, which results in serious infestation of other weeds. Weeds are of negative values, which lower the input efficiency. Besides quantitative effects on yield, weeds deteriorate the quality of produce through the physical presence of their seeds and debris. Weed density, type of the weeds, their persistence and crop management practices determine the magnitude of yield loss. Yield loss

in cowpea due to weeds was 12.7 - 60.0% in Nigeria" [3]. The phenomenon involved in crop yield increase as affected by different weed control method have already been well described by Mathew and Sreenivasan (1998), [4,5] reported that presence of weeds in cowpea reduced yield by 82% and significant increase in pod yield was noted by controlling weeds up to 45 days of sowing.

"Hand weeding is a common method of weed control adopted by farmers but comparatively this method is costly and time consuming. This problem assumes added significance due to non-availability of adequate laborers during peak period of operation. Whereas, pre- and post-emergence herbicides kill weeds and keep the hardy uncontrolled weeds under control by arresting their growth through various kinds of deformities in foliage, growing and pod point. The research information regarding appropriate practice of weed management in vegetable cowpea under this zone is not available" [5]. However, much needed information on the right kind of herbicides, time of application and rate as well as method of application are lacking in our country, especially with regard to vegetable crops.

2. MATERIALS AND METHODS

The experiment were conducted during *kharif,* 2021 at vegetable research farm, Department of vegetable science, Chandra Shekhar Azad University of Agriculture and Technology Kanpur (208002) (U.P.). The experiment included seven treatment combinations in a Randomized Block design with three replications. All the different combination of treatment *viz.,* T_1:Weedy check (Control), T_2:Weed free check (3 hand weeding) (first HW at 25 DAS) and (secand hand weeding at 45 DAS) and third hand weeding 60 DAS) T_3: Pre-emergence application of Pendimethalin @ 6ml/L T_4:Pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding T_5:Pre- emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS T_6: Post- emergence application of Metribuzin @ 525g/ha at 25DAS T_7: Post-emergence spray of Imazethapyr @ 100 g ai/ha at 25 DAS. The seeds of Kashi Kanchan were sown in a plot size of 3.15m×3.0m, spaced with 45cm×15cm. All other recommended cultural practices were followed to raise healthy crop. The observation was record in randomly taken and tagged plant from each other replication on morphological traits such as plant height (cm), Number of weeds per m^2 at 60 DAS, Pod length(cm), Number of pods per plant, Avg. pod weight (g) (Avg. of 10 pods), Green pod weight per plant(g), Green pod yield per plot(kg), Green pod yield per hectare (q).

3. RESULTS AND DISCUSSION

3.1 Plant Height

One of the key morphological traits associated with growth, plant height, has a significant impact on production. The considerably tallest plant was found in the weed-free test (T2) at 48.88 cm. Treatments T4 (pre-emergence application of pendimethalin at 6 ml/L plus one hand weeding with 47.30 cm) and T5 (pre-emergence application of pendimethalin at 6 ml/L plus quizalofop ethyl at 40–50 g/ha at 25 DAS with 45.98 cm) were applied after that. This may be because pre-emergence herbicidal treatment combined with hand weeding or post-emergence techniques reduced crop weed competition for the crop. The t1 weedy check (control) treatment yielded the smallest plants (26.16 cm). Similar findings were made by Usman (2013), Madukweet et al. (2012), Choudhary et al. (2013), and Fayinminnu and Adesiyan [6].

3.2 Pod Length

It is evident from the data that pod length was influenced significantly by different treatments of weed management practices. The pod length is one of the major yields attributing character and as such has a great bearing on green pod yield. The weed free check (T_2) produced significantly highest pod length (22.12 cm). It was followed by treatment T_4 pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding with 21.64 cm and T_5 pre- emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS with 20.86 cm. It might be attributed to effective weed management in the crop, which helps in minimum competition between crop plants and weeds. The shortest pod length (13.28 cm) was found under treatment T_1 weedy check (control). Similar findings are reported by Attia [7] and Olorunmaiye [8].

3.3 Number of Weeds/m^2 at 60 DAS

The statistics clearly show that various weed management techniques had a substantial impact on the number of weeds per m2 at 60 DAS. Although the weed-free check (T2) showed no weeds, treatments T4 and T5 that applied

pendimethalin prior to emergence and combined one-handed weeding with 40–50 g/ha of quizalofop ethyl at 25 DAS significantly reduced the number of weeds (48.12 and 52.18/m2, respectively). It could be attributable to effective weed management in both the early and later stages of the crop, whether through sequential weeding or post-emergence herbicide. Similar findings were also reported by Sah et al. [9]. Due to the intricate nature of the weed, single pesticide treatments proved ineffective in controlling it.

3.4 Number of Pods/Plants

It is evident from the data that number of pods/plants was influenced significantly by different treatments of weed management practices. The number of pods/plants is one of the major yields attributing character and as such has a great bearing on green pod yield. The weed free check (T_2) produced significantly highest number of pods/plant (37.04). It was followed by treatment T_4 pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding with 35.94 and T_5 pre- emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS with 34.18 pods. It might be attributed to effective weed management in the crop, which helps in minimum competition between crop plants and weeds. The lowest value of number of pods/plant (24.26) was found under treatment T_1 weedy check (control).

The results of Gutierrez et al. [10] Chattha et al. (2007), Hussaini and Lado [11] Olorunmaiye [8] Madukwe et al. [12] Choudhary et al. [13] and Usman [14] are all highly consistent with the findings shown above.

3.5 Average Pod Weight (g)

It is evident from the data that average pod weight was influenced significantly by different treatments of weed management practices. The average pod weight is also one of the major yields attributing character and as such has a great bearing on green pod yield. The weed free check (T_2) produced significantly highest average pod weight (11.24 g). It was followed by treatment T_4 pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding with 11.18 g and T_5 pre-emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS with 11.06 g. It might be attributed to effective weed management in the crop, which helps in minimum competition between crop plants and weeds. The lowest value of average pod weight (6.72 g) was found under treatment T_1 weedy check (control). The results are in propinquity with the result of [10] and Attia (2002).

3.6 Green Pod Weight/Plant (g)

It is evident from the data that green pod weight/plant was influenced significantly by different treatments of weed management practices. The green pod weight/plant is one of the major yields attributing character and as such has a great bearing on green pod yield. The weed free check (T_2) produced significantly highest green pod weight/plant (379.06 g). It was followed by treatment T_4 pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding with 367.84 g and T_5 pre- emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS with 348.63 g It might be attributed to effective weed management in the crop, which helps in minimum competition between crop plants and weeds. The lowest value of green pod weight/plant (144.45 g) was found under treatment T_1 weedy check (control). This might be due to stress experienced by the plants in this treatment. The findings corroborate the observations made earlier more or less by Sah *et al.* [9] and Gupta *et al.* (2016).

3.7 Green Pod Yield Per Plot (kg)

It is evident from the data that green pod weight/plot was influenced significantly by different treatments of weed management practices. The green pod weight/plot is one of the major yields attributing character and as such has a great bearing on yield per hectare. The weed free check (T_2) produced significantly highest green pod weight/plot (11.35 kg). It was followed by treatment T_4 pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding with 11.24 kg and T_5 pre-emergence application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS with 10.54 kg. It might be attributed to effective weed management in the crop, which helps in minimum competition between crop plants and weeds. The lowest value of green pod weight/plot (4.21 kg) was found under treatment T_1 weedy check (control). These findings are in the agreement with the findings of Hulugalle and Palada [15] Tripathi and Singh [5] Chinnusamy *et al.* (2010) and Hussaini and Lado [11].

Table 1. Effects of treatments on weed population, growth, yield attributes and green pod yield of cowpea

Treatment details		No. of weeds/m^2 at 60 DAS	Plant height (cm)	Pod length (cm)	No. of pods/ plant	Avg. pod wt. (g) (Avg. of 10 pods)	Green pod weight/ plant (g)	Green pod yield per plot (kg)	Green pod yield per hectare (q)
T_1	Weedy check (Control)	130.08	26.16	13.28	24.26	6.72	144.45	4.21	44.58
T_2	Weed free check (3 hand weeding) (first HW at 25 DAS)	0	48.88	22.12	37.04	11.24	379.06	11.35	120.07
T_3	Pre-emergence application of Pendimethalin @ 6ml/L	68.46	42.78	19.38	32.86	9.78	292.78	8.97	94.92
T_4	Pre-emergence application of Pendimethalin @ 6ml/L + one hand weeding	48.12	47.30	21.64	35.94	11.18	367.84	11.24	118.96
T_5	Pre- application of Pendimethalin @ 6ml/L + Quizalofop ethyl @ 40-50 g/ha at 25 DAS	52.18	45.98	20.86	34.18	11.06	348.63	10.54	111.55
T_6	Post- emergence application of Metribuzin @ 525g/ha at 25DAS	94.16	37.13	18.26	31.19	9.18	254.14	7.87	83.32
T_7	Post-emergence spray of Imazethapyr @ 100 g a.i./ha at 25 DAS	87.89	38.87	18.92	32.28	9.46	272.16	8.27	87.48
SEm±		2.42	1.53	0.76	1.22	0.44	10.92	0.32	3.38
CD (P=0.05)		7.46	4.72	2.34	3.77	1.34	33.64	0.98	10.42
CV		6.11	6.47	6.87	6.52	7.71	6.43	6.21	6.21

3.8 Green Pod Yield per Hectare (Q)

The findings clearly show that various weed management techniques had a considerable impact on the green pod yield per hectare. The green pod production per hectare (120.07 q) was significantly highest in the weed-free check (T2). Treatments T4 pre-emergence application of pendimethalin at 6 ml/L plus one-handed weeding with 118.96 q and T5 pre-emergence application of pendimethalin at 6 ml/L plus quizalofop ethyl at 40–50 g/ha at 25 DAS with 111.55 q were applied after it. It could be explained by the fact that there are enough nutrients, soil moisture, spaces, and lights available for crop use. Under treatment T1 weedy check (control), the lowest value of green pod yield per hectare (44.58 q) was discovered. This might be because the plants receiving this treatment were stressed.

Similar result was observed by Hulugalle and Palada (1990), Singh and Katyal [15-18]. Tripathi and Singh [5] Chinnusamy et al. (2010), and Hussaini and Lado [11] all reached similar conclusions [19,20].

4. CONCLUSION

Pre-emergence application of Pendimethalin @ 6ml/L supplemented with one hand weeding and sequential application of Pendimethalin @ 6ml/L with Quizalofop ethyl @ 40-50 g/ha at 25 DAS can manage the weeds effectively in cowpea and offered highest economic returns. Hence, these two weed management practices may serve as alternative of manual weeding and may be recommended for farmers of the central plain zone of Uttar Pradesh for higher returns from cowpea crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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