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K Choube
Department of Vegetable Science, M.Sc. (Ag), RAK College of Agriculture, Sehore, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalya, Gwalior, Madhya Pradesh, India

DK Raidas
Department of Plant Physiology, RAK College of Agriculture, Sehore, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalya, Gwalior, Madhya Pradesh, India

RK Jaiswal
Department of Vegetable Science, RAK College of Agriculture, Sehore, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalya, Gwalior, Madhya Pradesh, India

S Chakraborty
Department of Home Science, F.R.S. Entkhedi Bhopal, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalya, Gwalior, Madhya Pradesh, India

Corresponding Author:
K Choube
Department of Vegetable Science, M.Sc. (Ag), RAK College of Agriculture, Sehore, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalya, Gwalior, Madhya Pradesh, India

Effect of different weed management practices on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis* L.)

K Choube, DK Raidas, RK Jaiswal and S Chakraborty

Abstract
A field experiment was conducted during Rabi, 2018-19 at RAK College of Agriculture, Sehore (M.P.) to study the effect of different weed management practices on growth and yield of cauliflower. The treatments namely - T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT, T_5 - Propaquizafop 10% EC (POE) + 1 HW at 60 DAT, T_6 -Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm) were evaluated in randomized block design with three replications. Results indicated that the T_7 -Black plastic mulch (150 mm) recorded maximum value of plant height (cm), stalk length (cm), number of leaves/plant, Leaf area (cm^2), Chlorophyll content (SPAD value) and yield attributing characteristics curd length, curd width, average curd weight, curd yield and marketable curd yield (q/ha). It was followed by T_2 - weed free (through hand weeding) at 30 & 60 DAT. Maximum plant height, stalk length, number of leaves/plant, Leaf area (cm^2) and Chlorophyll content (SPAD), total curd yield (q/ha) and marketable curd yield (q/ha) was recorded with the treatment T_7- Black plastic mulch (150 mm).

Keywords: Growth, leaf area, plant height, SPAD, weed, yield

1. Introduction
Cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the most popular vegetable crop among the Cole crops and has originated from the mediterranean region. It was introduced in our country in 1822. Cauliflower belongs to family brassicaceae and is grown for its white tender curd which is used for vegetable, curry, soup and pickle preparations. Besides being good source of protein and carbohydrates, cauliflower is a rich source of vitamins and minerals (Bana *et al.*, 2012) [1]. India ranks second in area and production of cauliflower in the world after China. In India major cauliflower growing states are West Bengal, Bihar, Maharashtra, Madhya Pradesh, Orissa, Gujarat and Haryana etc. It is grown in an area of 435.9 thousand hectare with production of 8573.3 thousand metric tones and productivity of 19.8 metric tons per hectare in India. In Madhya Pradesh, it is grown in an area of 25.1 thousand hectare with a production of 70.38 metric tons and highest productivity of 28.1 metric tones per hectare (NHB, 2015) [5]. In India annually undergoes considerable loss due to various stresses of the agriculture and among these, weeds top the list by contributing 33% towards total loss. Weeds interfere with crop plants severely reduce crop growth and lower yield and quality (Mal *et al.*, 2005) [4]. Although considerable research work has been carried out in India on various aspects of cauliflower cultivation, but the problem of weeds in this crop need special attention, as weeds when present in the field reduce the yield and impair the quality of the produce for vegetable purposes, the crop remain in the field for about four months and during its growth period, the crop faces competition due to presence of monocot and dicot weed. Keeping in view the seriousness of weed problems, high cost of manual labor and availability of different herbicides, the present investigation was planned to assess the effect of weed management practices on growth and yield of cauliflower.

2. Materials and Methods
The field experiment was conducted during Rabi season, 2018-19 at Research Field of the Department of Vegetable Science, RAK College of Agriculture, Sehore (M.P). Seven treatment consisted T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT, T_5 - Propaquizafop 10% EC (POE) + 1 HW at 60 DAT, T_6 -Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm) were arranged in randomized block design with three replications.

The land was prepared by deep ploughing, harrowing and leveling and thereafter plots were prepared. The calculated quantities of fertilizers were applied to the each plot. The source of nutrients were nitrogen (DAP, Urea), phosphorus (DAP), potash (MOP). Half of nitrogen and whole dose of phosphorus and potash were applied as basal dose before transplanting of cauliflower seedlings. While the remaining half dose of nitrogen was given in 2 equal split doses, at 30 and 45 days after transplanting. Pure and healthy forty two days old seedlings of uniform height were selected and transplanted in the field with the spacing of 50 x 45 cm. Irrigation was given immediately after transplanting and gap filling was done at 10 days after transplanting, to maintain the plant population in each plot and light irrigation was given just after gap filling of seedlings. The required amount of herbicides for the experimentation was calculated by using the following formula.

$$\text{Required chemical} = \frac{\text{a.i./ha} \times 100}{\text{EC}}$$

Thus, spray of calculated amount of herbicide was done to each treatment plot using knapsack sprayer with a spray volume of 750 liters of water per hectare. The pre-emergence herbicides Pendimethalin and Oxyfluorfen were applied as spray uniformly two days before transplanting of cauliflower seedlings. The post emergence herbicide Propaquizafop was applied uniformly 25 days after transplanting as per treatment. All the operations done regularly during growing season. After complete development, the different plant growth parameter *viz* plant height, stalk length, number of leaves/plant, Leaf area (cm^2) was determined by leaf area meter with conveyer attachment, Chlorophyll content was determined by using Minoltas SPAD 502 plus Chlorophyll meter. The instruments measuring the relative amount of chlorophyll present in plant leaves in unit of SPAD (Soil Plant Analysis Development). It is work on the principal of value of measured chlorophyll correspondent to base on light transmitted by the leaf in two wave length reason in which the absorbance of chlorophyll is different. observations were recorded on five randomly selected plants from every treatment on 30 days, 60 days and 90 days after transplanting of seedling. and yield attributing characteristics curd yield (q/ha) and Marketable curd yield (q/ha) at the harvesting. Finally mean data of the all characters were computed for statistical analysis as per standard procedure given by (Panse and Sukhtme 1989) [6].

3. Results and Discussion

(I) Growth parameters

3.1 Plant height (cm): The plant height per plant at 30, 60 and 90 days of the crop is presented in (Table- 1). There was significant effect of weed management practices on all the growth stages except 30 days of crop on plant height. The plant height increases with the advancement in growth stage in cauliflower. Among the weed management practices, treatment T_7- Black plastic mulch (150 mm) recorded maximum plant height (7.36, 19.72 and 25.04 cm) at 30,60 and 90 days of plant followed by treatment T_2- weed free (through hand weeding) at 30 & 60 DAT). While the minimum plant height of all the growth stages were recorded under treatment T_1- Weedy check (control). This increase in growth of plant height could be due to no weed competition and lower in case of T_1 (weedy check) due to continuous competition of weeds which reduced the plant height due to poor exposure to sunlight and competition for nutrient and water. Similar results were reported by by Bana *et al.* (2012) [1] and Sen *et al*. (2018) [8] in cauliflower.

3.2 Stalk length (cm): The stalk length(cm) per plant at 30 days, 60 days and 90 days of the crop is presented in (Table-1). The effect of weed management practices was significant of crop on stalk length (cm) per plant. Among the weed management practices, treatment T_7- Black plastic mulch (150 mm) recorded maximum stalk length(cm) (5.60, 9.09 and 11.33 cm) at 30, 60 and 90 days of plant followed by treatment T_2- weed free through hand weeding) at 30 & 60 DAT (5.65), T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT (9.02) and T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT (10.83) as compare to control. This increase in growth of stalk length could be due to no weed competition and lower in case of T_1 (weedy check) due to continuous competition of weeds which reduced the stalk length due to poor exposure to sunlight and competition for nutrient and water. Similar results were reported by Qasem (2009) [7] in cauliflower.

3.3 No. of Leaves/plant: The no. of leaves per plant at 30 days, 60 days and 90 days of the crop is presented in (Table-1). The effect of weed management practices was significantly on number of leaves per plant at 30 and 60 days except 90 days of crop. Among the weed management practices, treatment T_4 - Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT the maximum no. of leaves per plant (8.88) at 30 days, similarly treatment T_7- Black plastic mulch (150 mm) maximum no. of leaves was recorded at 60 and 90 days (12.66, 13.44) while the minimum value of no. of leaves/plant all the growth stages were recorded under treatment T_1 (weedy check). This increase in no. of leaves/plant could be due to no weed competition and suitable environments for crop.

3.4 Leaf area (cm^2): Leaf area was recorded at 30, 60 and 90 DAT is presented in (Table -1). Significant effect of weed management practices on leaf area at all the stages except 90 days. In general, there was increase in leaf area up to 60 DAT. The maximum leaf area was recorded under treatment T_7- Black plastic mulch (150 mm) i.e. 72.21, 81.48 cm^2 at 30 and 60 DAT respectively and it was followed by treatment T_2- Weed free (through hand weeding) which had recorded 70.60, 74.81cm^2 of leaf area at 30 and 60 DAT, respectively and the maximum leaf area was recorded under treatment T_2- Weed free (through hand weeding) i.e 92.91 at 90 DAT respectively and it was followed by treatment T_7- Black plastic mulch (150 mm) which had recorded 92.80 cm^2 respectively as compare to control. Weed control treatments increased availability of nutrients, moisture and space to crop which results into ultimately increased Leaf area. Similar finding have been reported by Vishnu *et al.* (2015) [9] in onion.

3.5 Chlorophyll content (SPAD Value): The chlorophyll content (SPAD) was at 30, 60 and 90 DAT is presented in (Table -1) revealed significant influence of weed management practices on Chlorophyll content at 60 DAT except 30 and 90 DAT. Among the Weed management practices, maximum chlorophyll content i.e 41.43, 52.66 and 48.61 at 30, 60 and 90 DAT observed under the treatment T_7- Black plastic mulch (150 mm) and it was followed by treatment T_2- Weed free (through hand weeding) which had recorded 40.30, 50.50 and

46.90 at 30, 60 and 90 DAT, respectively. minimum chlorophyll content (SPAD) was in leaves was found under the treatment T_1- weedy check at the all the stages of crop. Better growing conditions *viz*., availability of more light, nutrients and water due lesser crop-weed competition with have resulted in more chlorophyll content under the treatments T_7- Black plastic mulch (150 mm). Similar results were also noticed by Channappagoudar *et al*. (2008) [9] in radish.

(II) Yield parameters

The Total curd yield (q/ha) and marketable curd yield (q/h) was at harvesting is presented in (Table-1). The maximum curd yield (q/ha) and marketable curd yield (q/h) were recorded under the treatment T_7- Black plastic mulch (150 mm) i.e. (304.23, 271.31) followed by treatment T_2- Weed free (through hand weeding) which had recorded (267.05, 245.50). While the T_1 (weedy check) recorded minimum total curd yield and marketable curd yield respectively. The higher synthesis and accumulation of photosynthates in the plant resulted in increasing ultimately yield of crop. Similar finding were also reported by Mal *et al.* (2005) [4] in cauliflower.

Table 1: Effect of different weed management practices on growth & yield parameters of Cauliflower (*Brassica oleracea* var. *botrytis* L.)

Treatments	Plant height (cm)			Stalk length (cm)			No. of Leaves/ plant			Leaf area (cm^2)			Chlorophyll content (SPAD Value)			Total curd yield (q/ha)	Marketable curd yield (q/h)
	30 Days	60 Day	90 Day	30 Days	60 Day	90 Day	30 Days	60 Day	90 Day	30 Days	60 Day	90 Day	30 Days	60 Day	90 Day		
T_1	5.00	11.58	19.00	3.24	5.94	8.22	4.88	7.43	11.00	50.59	64.31	73.64	28.85	43.50	37.85	121.73	115.89
T_2	5.75	16.03	24.68	5.65	8.32	10.75	6.77	10.45	13.44	70.60	74.81	92.91	40.30	50.50	46.90	267.05	245.50
T_3	6.46	15.46	22.69	3.78	8.49	10.83	6.77	11.34	11.44	69.91	70.53	78.38	38.82	48.10	45.62	179.57	168.15
T_4	6.02	15.25	21.42	5.71	9.02	9.69	8.88	11.34	12.66	51.75	70.00	87.42	37.49	45.22	43.82	246.23	228.55
T_5	5.27	13.96	22.74	3.72	6.57	9.05	6.11	10.90	12.77	48.12	69.91	89.32	35.06	35.17	39.09	155.24	135.30
T_6	5.40	15.07	22.28	3.54	7.27	9.28	5.55	10.24	11.88	56.95	68.99	78.72	38.57	43.39	41.55	144.12	130.26
T_7	7.36	19.72	25.04	5.60	9.09	11.33	7.55	12.66	13.44	72.21	81.48	92.80	41.43	52.66	48.61	304.23	271.31
SE (m) ±	0.49	1.18	1.2	0.61	0.66	0.63	0.60	0.81	0.76	5.03	3.00	5.38	2.48	2.09	2.85	5.54	5.95
C D at 5%	NS	3.66	3.69	1.89	2.05	1.95	1.86	2.51	NS	15.50	9.25	NS	NS	6.43	NS	17.08	18.32

DAT- Day After Transplanting, SPAD- Soil Plant Analysis Development, T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT, T_5 - Propaquizafop 10% EC (POE) + 1 HW at 60 DAT, T_6 -Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm)

4. Conclusion

On the basis of present experiment, it may be conducted that plant growth parameter *viz* plant height, stalk length, number of leaves/plant, Leaf area (cm^2) and chlorophyll content and yield attributing characters, higher yield and lesser weed as well as maximum gross and net return was recorded by weed management practices treatment T_7- Black plastic mulch (150 mm) followed by treatment T_2- weed free (through hand weeding) treatment and T_6 -Wheat straw mulch and T_3 - Pendimethalin 30% EC (PE) + 1 HW at 30 DAT at 30, 60, 90 DAT. Thus appropriate choice for weed control in cauliflower would be an integration of cultural and herbicidal control for boosting the cauliflower production. Besides hand weeding and mulching (particularly plastic mulch) has also been advocated by many researchers as an effective mean for reducing weed population.

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