MIJRD Multidisciplinary International Journal of Research and Development

Multidisciplinary International Journal of Research and Development

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

Effect of Removal of Terminal and Axillary Heads and Thinning of Central Flower Clusters on the Yield and Quality of Seeds of Broccoli (Brassica oleracea var. Italica Plenck.) cv. Calabrese in the Plain Areas of Chitwan

K. D. Dawadi

Tribhuvan University, Institute of Agriculture and Animal Science, Nepal

Abstract— An experiment was conducted on broccoli (Brassica oleracea var. Italica) cv. Calabrese during the winter season, 2004/05 in Fulbari Village Development Committee, Chitwan, Nepal to find out the suitable treatment measures for quality seed production. The treatments imposed were i) no removal of any heads (control) ii) removal of terminal head just after sprouting iii) removal of terminal head at marketable stage iv) removal of terminal plus first two axillary heads at marketable stage v) removal of all axillary heads at marketable stage and vi) retain only terminal head with thinning of 50% flower stalks at the stage when flower buds begin to open and removal of all axillary heads at marketable stage. The experiment was conducted in Randomized Complete Bock Design (RCBD) with six treatments and replicated four times. Seed yield/ha was found highest (1148 kg) with the treatment removal of terminal head at marketable stage. Germination percentage did not differ among the treatments. The treatment with thinning of 50% central flower clusters with removal of all axillary heads at marketable stage had higher amount of 1000 seed weight (3.900 g) which was statistically at par with the treatment with removal of terminal head at marketable stage (3.885 g). Since the treatment removal of terminal head at marketable stage produced higher seed yield (1148 kg/ha) along with fresh vegetable crop (1285 kg/ha) and gave more economic return (Rs. 950525/ha) by selling them and no statistical difference with other treatments was observed in quality parameters, this treatment was identified as superior measure for producing good quality seed in the plain areas of Chitwan.

Keywords— Broccoli head, broccoli seed, thinning of broccoli head, thinning of central flower.

INTRODUCTION

Broccoli (Brassica oleracea var. Italica), which is a member of the Brassicaceae family, is a compact, rapidly developing floral vegetable that is usually harvested when the flowering heads are immature (Gray, 1982). It was introduced to England in the early 16th century as “Italian asparagus” or “sprouting cauliflower”. It is one of the best and economically lucrative vegetables and more nutritious than any other vegetables of the same genus. It is a good source of carotene (575 µg), vitamin C (87 mg) (value based on 100 g fresh weight), riboflavin (vitamin B2) and also rich in dietary fiber (Rashid, 1996; Rangavajhyala et al., 1998). Broccoli contains a high level of sulforaphane glucosinolates, which possess cancer-inhibiting quality (Fahey et al., 1997). The American Cancer society suggested the inclusion of broccoli in the human diet to reduce the risk of developing cancer (Lindsay et al., 1988).

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

The edible portion of the broccoli plant consists of the tender stem or stalk and the unopened flower buds (Sanders, 1999). The usual types of sprouting broccoli first develop a central head of green color, and a number of smaller axillary stalks bearing smaller heads, which are sold in bunches. If the central flower cluster is cut out, the small sized clusters born on axillary stalks. Thus the edible part can be harvested over a long period of time (Reiley and Carrol, 1983). Calabrese is the most popular group of varieties of broccoli (Rangavajhyala et al., 1998; VDD, 1990; Thompson and Kelly, 1979). The seed production of broccoli is difficult in the areas having severe winter (Sinohara, 1984). So the suitable place for seed production is recognized where the winter is mild, spring comes earlier and rainfall is less during flowering and ripening period. In Nepal, The seed production of broccoli can be done from terai to high hilly region (VDD, 1990). Broccoli is comparatively a newer winter vegetable in Nepal (Ghimire et al., 1993). Its production is mostly limited to kitchen garden and only for fresh consumption although there are cases where it is being demonstrated extensively in village areas as a cash generator. For example, in the Koshi hills, it has been grown by farmers both for fresh as well as seed purpose (Ghimire et al., 1993). Farmers regard broccoli seed production as a source of cash generator because of its high value nature (Ghimire et al., 1993).

Quality seed is the basis for increasing production and productivity of broccoli sprouts as well as seeds. However, one of the major problems associated with this crop in Nepal is lack of availability of high quality seeds of desired varieties (Devkota, 2000). The total production of foundation seed of broccoli in Nepal during 1999/2000 was only 2 kg (VDD, 2000). Likewise, the transaction of seed of open pollinated variety was only 263 kg during 2000/2001 out of which in country production was only 98 kg and the rest was imported from abroad (VDD, 2001). This indicates that the production of broccoli seed in Nepal is very low.

In the literature, it has been reported that the heads in the axil of the leaves develop strongly, especially after the removal of the terminal head (Chatterjee, 1986). It was also observed that when apical head is removed then side heads produce profuse seeds (Firoz et al., 2000). Broccoli had a poor seed yield where terminal and axillary heads were left intact. Removing the terminal head or axillary heads yielded equally good seed as compared to heads not removed (Ghimire et al., 1993). Sukthong (1993) reported that thinning of 75% of central flower clusters gave the highest seed yield. Similarly, thinning of flower clusters at matured bud stage gave the highest seed yield and also the speed of germination (Sukthong, 1994). However, information on the influence of terminal head and/or axillary head removal on seed yield and its quality in broccoli is very scanty. So the present study was undertaken with a view to evaluate the influence of such various measures on seed production with focus on seed yield and quality in the plain areas of Chitwan.

MATERIALS AND METHODS

Field experiment was conducted in the farmer's field at then Fulbari Village Development Committee near Institute of Agriculture and Animal Science (IAAS), Rampur. The field experiment was carried from September 13, 2004 to March 23, 2005 with a popular variety of broccoli Calabrese, the seed of which is being maintained at Horticulture farm, Institute of Agriculture and Animal Science, Rampur, Chitwan. The altitude of the experimental site is about 256 meter above mean sea level and geographically, it is situated at 270 37' to 270 46' North latitude and 830 35'

to 840 48' East longitude. Before conducting the research, the field was cropped with black gram. The soil was physically sandy loam and acidic in nature (pH 5.4).

The lay-out was carried out into Randomized Complete Block Design (RCBD) with 6 treatments and 4 replications. The individual plot size was 9 m2 (3 m x 3 m). The row to row and plant to plant distance was maintained at 60 cm. There were 5 rows in each plot and 5 plants were incorporated in each row. Among the 25 plants in each plot, only nine inner plants were considered for observations. The treatments included in the study were

- T1: No removal of any heads (seeds were taken from both terminal and axillary heads),
- T2: Removal of terminal head (bud) just after sprouting (seeds were taken from axillary heads),
- T3: Removal of terminal head at marketable stage for fresh consumption (seeds were taken from all axillary heads),
- T4: Removal of terminal head plus first two axillary heads at marketable stage for fresh consumption (seeds were taken from the remaining axillary heads),
- T5: Removal of all axillary heads for fresh consumption at marketable stage (retain only terminal head and seeds were taken from it) and
- T6: Retain only terminal head with thinning of 50% flower stalk at the stage when flower buds begin to open and removal of all axillary heads at marketable stage for fresh consumption (seeds were taken from the remaining terminal head)

Farmyard manure (FYM) was applied @ 25 t/ha at the time of final land preparation. Similarly, the soil was fertilized with 100:80:60 kg NPK/ha through urea, diammonium phosphate (DAP) and murate of potash (MOP), respectively. Full dose of phosphorus and potash and half dose of nitrogen was applied as a basal dose at the time of final land preparation before transplanting the seedlings and remaining ½ dose of nitrogen was applied as side dressing in two equal doses i. e. at 40 days after transplanting (heading stage) and 67 days after transplanting (Pod formation stage).

Likewise, borax @ 20 kg/ha was applied at the time of final land preparation. Uniform sized thirty-seven days old healthy seedlings were transplanted in the experimental plots on October 19, 2004. Cultural practices including sprays of insecticides were uniformly carried out as required.

The observations recorded in the field study were plant height, plant spread, main stem diameter, days to first flowering, days to 50% plant flowering, numbers of flowers per plant, fresh vegetable yield, number of pods per plant, percent pod set, days to first and the last picking of pods, pod length, number of seed per pod, seed yield.

Similarly, germination %, 1000 seed weight, seedling shoot and root length, fresh and dry weight of seedling, seed vigor index-I and vigor index-II were recorded in the laboratory experiment which was conducted at the Horticulture laboratory of IAAS from May 1 to 13, 2005.

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

RESULTS AND DISCUSSION

Among the parameters observed, plant spread, main stem diameter, number of seeds/pod, germination %, seedling length, seedling dry weight, vigor index I and vigor index II were found non significant among the treatments. Days to first flowering, days to fifty percent plant flowering, number of flowers/plant, fresh vegetable yield (kg/ha), number of pods/plant, pod set %, pod length, seed yield (kg/ha), plant height, 1000 seed weight and seedling fresh weight were found significantly different among the treatments.

Plant height

Plant height differed significantly among the treatments. It was 134.7 cm in T2 which was at par with T3 (130.1 cm), T6 (126.6 cm) and T4 (125.0cm). T5 (removal of axillary heads at marketable stage) and control produced shorter plants (119.1 cm and 112.0 cm respectively) (Table 1). This result contradicts with the findings of Firoz et al. (2000) who demonstrated no significant difference in plant height between removal and non-removal of the terminal heads.

Plant spread

Data pertaining to the influence of removal of terminal and axillary heads and thinning of central flower clusters is presented in Table 1 and analysis of variance is appended in Appendix 2. The difference in plant spread as affected by treatments was not significant among the treatments. However, T3 showed the highest plant spread (106.45 cm) followed by T2 (102.83 cm) and T4 (99.00 cm). This finding supported the result reported by Firoz et al. (2000) who also reported no significant difference in plant spread in either terminal head removal or non-removal.

Days to first flowering

The treatments influenced days to first flowering significantly (Table 1). T4 took significantly more days (57.50 DAT) for flower initiation which was at par with T3 (55.25 DAT) followed by T2 (54.50 DAT). T6 took less number of days (49.00 DAT) for flower initiation and it was at par with T5 (49.25 DAT) followed by T1 (50.25 DAT).

Days to 50% plant flowering

Statistical analysis shows that days to fifty percent plant flowering was also found significant. It took less number of days (54.50 days) in T6 which was at par with T5 (55.50 days) and T1 (58.50 days). However, T4 attained 50% flowering 67.25 days after transplanting which was significantly longer (Table 1). The initiation of new axillary heads in treatment 4 where terminal head and first two axillary heads were removed at marketable stage, took longer time to reach to physiologically mature stage resulting into delay in 50% flowering.

Number of flowers per plant

Average number of flowers per plant differed significantly among the treatments. The highest number of flowers was counted in T1 (3593) followed by T2 (2914), T3 (2830) and T6 (2527), the latter treatments being at par with each other. T5 and T4 produced lowest number of flowers (2241 and 2321 respectively) (Table 1). The highest

number of flowers in control treatment (T1) can be attributed to more number of floral branches in terminal head as well as in axillary heads.

Fresh yield (g/plot and kg/ha)

The fresh harvest was obtained from only with four treatments except T1 and T2. Control (T1) and T2 (removal of terminal head just after sprouting) did not have any fresh yield. In control, seeds were harvested from both terminal and axillary heads. In T2, seed was harvested from axillary heads. Removal of terminal head immediately after sprouting did not have appreciable edible fresh yield, so it was also not included in the comparison of fresh yield. Statistical comparisons were made only among rest of the four treatments. The treatment effect on fresh yield was highly significant. The highest fresh yield was obtained from T4 (1719 gram/plot) which was at par with T6 (1426 gram/plot) followed by T3 (1156.5 gram/plot).

T5 was noted as the least producer of fresh yield (836.8 gm/plot). In terms of hectare, the highest fresh yield was obtained from T4 (1910 kg/ha) which was at par with T6 (1584 kg/ha) followed by T3 (1285 kg/ha). The lowest fresh yield was obtained from T5 (929.8 kg/ha) (Table 1). The highest fresh edible yield in T4 was obvious because this treatment was meant for obtaining more fresh yield and to see its effect on seed production and quality. But the result obtained from T3 in the present study contradicts with the report of Ghimire et al. (1993) who reported 4380 kg/ha fresh yield from the removal of terminal heads. It also contradicts with the report of Neupane (2004). He reported the terminal and axillary head yield (fresh yield) of 3180 kg/ha and 4798 kg/ha respectively in the plain areas of Chitwan.

Number of pods per plant

The average number of pod/plant due to treatments differed significantly (Table 2). It was maximum in T3 (835.8) which was at par with T2 (812.5). The lowest number of pod/plant was recorded in T5 (590.5). This finding is in agreement with Firoz et al. (2000). However, less number of pods/plant in T4 can be attributed to the less number of branches due to the removal of terminal and first 2 axillary heads.

Pod set percentage

The treatment effect on this character was significant. Highest pod set percentage was found in T3 (29.53%) which was at par with all other treatments except T1 (control) bearing lowest pod set percentage (19.97 %) (Table 2). Compared to control treatment, the higher pod set percentage in the treatment with removal of terminal head, axillary heads and thinning of central flower cluster might be due to the availability of open space for bees to pollinate the flowers and good light interception inside the plants.

Days to 1st and last picking of pods

With respect to days to first picking of pods, the treatments did not differ. However, it was slightly longer in T4 (135) than rest of the treatments (123 DAT). Days to last picking of pods also did not differ since pods from all the treatments were harvested in the same day which was 156 DAT. The pods from all the treatments were harvested 5 times except from the T4 which was harvested only 4 times.

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

Pod length

Treatments affected mean pod length significantly (Table 2). Longer pod was recorded in T2 (6.125 cm) which was at par with T3 (6.005 cm) and T6 (5.825 cm). The shortest pod length was recorded in T1 (control) which was 5.0 cm. The present finding contradicts with the report given by (Ghimire et al., 1994) who reported slightly longer pod length in treatment involving removal of axillary heads. However, the present study showed longer pod length from the treatments with removal of either terminal or axillary head.

Seed yield/plant

Data regarding the effect of treatments on mean seed yield/plant was differed among the treatments (Table 2). It was recorded highest in T3 (41.32 g) which was at par with T2 (38.23 g) and T6 (32.54 g) followed by other treatments. However, lowest seed yield was recorded in T5 (25.92 g). The lowest seed yield obtained from control treatment as well as treatment with removal of only axillary heads at marketable stage might have been due to the poor aeration and also the poor light incidence inside the plant because of the compact terminal head size.

Seed yield/ha

With respect to seed yield, the highest yield was obtained from T3 which was 1148 kg/ha. Significantly lowest seed yield/ha was obtained from T5 which was only 720 kg/ha (Table 2).

1000 seed weight

Table 3 shows that the effect of treatments on 1000 seed weight was significant among the treatments. Highest weight was recorded in T6 (3.900 g) which was at par with T3 (3.885 g) and T4 (3.880 g) followed by rest of the treatments. The highest seed weight in the treatments with removal of terminal heads and thinning of heads might be due to free air circulation, better pollination and entry of light and less competition among flowers. More compact heads with probably less bee activities may be the reason for less thousand seed weight in case of control and the axillary heads removed.

Seedling fresh weight

The effect of treatments on seedling fresh weight was found significant. It was 0.07800 g in T6 which was at par with T3 (0.07450 g) and T2 (0.06975 g) (Table 3). The highest seedling fresh weight in T6 which was statistically identical with T2 and T3 might be due the weighty seeds obtained as a result of better pollination, aeration and light interception to the floral parts.

Comparison of various treatments with respect to seed yield, fresh yield, seed quality as well as gross income from the seed and fresh products

Comparison of various treatments with respect to seed yield, fresh yield, seed quality, as well as gross income from seed and fresh products is presented in Table 4. The seed yield was highest in T3 (1148 kg/ha) which was at par with T2 (1062 kg/ha) followed by T6 (904 kg/ha). Germination percentage did not differ statistically among the treatments. It was 77.5% in T6 followed by 75% and 74.5% in T3 and T2 respectively. Likewise, Vigor Index I and Vigor Index II also did not differ among the treatments. With respect to 1000 seed weight; T3, T4 and T6 gave

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

similar result which was 3.885g, 3.880g and 3.90g respectively. On the other hand, fresh yield was highest in T4 (1910 kg/ha) which was statistically similar to T6 (1584 kg/ha) followed by T3 (1285 kg/ha).

The total gross income/ha was highest from T3 (removal of terminal heads at marketable stage) i.e. Rs.950525 followed by T2 (removal of terminal head just after sprouting) which was Rs. 849600.

The lowest income was obtained from T5 (removal of axillary heads at marketable stage) and T1 (control) which were Rs. 599245 and Rs.673530 respectively.

The highest gross income obtained from T3 is due to the higher seed production per hectare and its market value although fresh vegetable production from this treatment was comparatively lower than those from the treatments T4 and T6.

Table 1: Effect of removal of terminal and axillary heads and thinning of central flower clusters on plant height, plant spread, main stem diameter, days to first flowering, days to fifty percent plant flowering, number of flowers per plant and fresh yield/plot/ha of broccoli in the plain areas of Chitwan during 2004/05.

Treatments	Plant height (cm)	Plant spread (cm)	MSD (cm)	DFF1	DFF2	Flowers/plant	Fresh yield (gm/plot)	Fresh yield (kg/ha)
T1	112.00 c	89.79	3.56	50.25bc	58.50 b	3593 a	0	0
T2	134.70 a	102.83	3.38	54.50 abc	65.00 a	2914 b	0	0
T3	130.1 ab	106.45	3.61	55.25 ab	64.75 a	2830 bc	1156.5 bc	1285 bc
T4	125.00 abc	99.00	3.65	57.50 a	67.25 a	2321 cd	1719 a	1910 a
T5	119.10 bc	82.95	3.74	49.25 c	55.50 b	2241 d	836.8 c	929.8 c
T6	126.60 ab	87.12	3.70	49 c	54.50 b	2527 bcd	1426 ab	1584 ab
S Em	4.42	6.72	0.1410	1.336	0.9498	126.1	102.1	113.4
LSD Value	13.32*	ns	ns	5.568**	3.941**	525.4**	469.1**	521.2**
CV %	7.09	14.21	7.81	5.08	3.11	9.21	15.89	15.89

MSD- Main stem diameter DFF1- Days to first flowering DFF2- Days to fifty percent plant flowering * Significant at 0.05 level of significance

** Significant at 0.01 level of significance

ns- non significant

Values with the same letters are not significantly different at 1% (**) and 5% (*) level by DMRT.

- T1 = Control (No removal of any heads)
- T2 = Removal of terminal head just after sprouting
- T3 = Removal of terminal head at marketable stage for fresh consumption
- T4 = Removal of terminal head plus first two axillary heads at marketable stage for fresh consumption
- T5 = Removal of all axillary heads at marketable stage for fresh consumption
- T6 = Retain only terminal head with thinning of 50% flower stalk at the stage when flower buds begin to open and removal of all axillary heads at marketable stage for fresh consumption

MIJRD Multidisciplinary International Journal of Research and Development

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

Table 2: Effect of removal of terminal and axillary heads and thinning of central flower clusters on number of pods/plant, podset %, pod length, number of seeds/pod and seed yield/plant/plot/ha of broccoli in the plain areas of Chitwan during 2004/05.

Treatments	No. of pods/Plant	Pod set%	Pod length (cm)	No. of seeds/pod	Seed yield (g/plant)	Seed yield (g/plot)	Seed yield (kg/ha)
T1	712.6 abc	19.97 b	5.000 b	11.200	30.31 bc	757.8 bc	842.0 bc
T2	812.5 ab	27.86 a	6.125 a	12.300	38.23 ab	955.8 ab	1062.0 ab
T3	835.8 a	29.53 a	6.005 a	12.750	41.32 a	1033.0 a	1148.0 a
T4	659.6 c	28.48 a	5.550 ab	12.150	31.03 bc	775.9 bc	862.1 bc
T5	590.5 c	26.34 a	5.400 ab	11.275	25.92 c	648.0 c	720.0 c
T6	683.6 bc	27.16 a	5.825 a	12.175	32.54 abc	813.6 abc	904.0 abc
S Em	45.98	1.509	0.1673	0.4835	2.878	71.96	79.96
LSD Value	138.6*	6.289**	0.6973**	ns	8.676*	216.9*	241.0*
CV %	12.85	11.36	5.92	8.08	17.33	17.33	17.33

* Significant at 0.05 level of significance ** Significant at 0.01 level of significance ns- non significant

Values with the same letters are not significantly different at 1% (**) and 5% (*) level by DMRT.

- T1 = Control (No removal of any heads)
- T2 = Removal of terminal head just after sprouting
- T3 = Removal of terminal head at marketable stage for fresh consumption
- T4 = Removal of terminal head plus first two axillary heads at marketable stage for fresh consumption
- T5 = Removal of all axillary heads at marketable stage for fresh consumption
- T6 = Retain only terminal head with thinning of 50% flower stalk at the stage when flower buds begin to open and removal of all axillary heads at marketable stage for fresh consumption

Table 3: Effect of removal of terminal and axillary heads and thinning of central flower clusters on germination %, 1000 seed weight, seedling length, seedling fresh and dry weight, vigor index- I and vigor index- II of broccoli in the plain areas of Chitwan during 2004/05.

Treatments	GM %	1000 seed weight (g)	Seedling length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Vigor index I	Vigor index II
T1	73	3.793 b	8.66	0.0668 abc	0.00435	12.54	626.9
T2	74.50	3.810 b	8.63	0.0698 ab	0.00460	12.63	640.7
T3	75	3.885 a	9.03	0.0745 ab	0.00450	13.76	674.5
T4	74.50	3.880 a	8.9	0.0537 c	0.00360	13.00	663.0
T5	73	3.830 b	8.9	0.0625 bc	0.00345	12.99	653.9
T6	77.5	3.900 a	9.0	0.0780 a	0.00400	14.38	696.6
S Em	2.78	0.01052	0.626	0.00468	0.000425	0.520	44.2
LSD Value	ns	0.03127**	ns	0.01391*	ns	ns	ns
CV %	7.5	0.55	14.1	13.9	20.8	7.9	13.4

GM % – Germination %

** Significant at 0.01 level of significance

ns- non significant

Values with the same letters are not significantly different at 1% (**) and 5% (*) level by DMRT.

- T1 = Control (No removal of any heads)
- T2 = Removal of terminal head just after sprouting
- T3 = Removal of terminal head at marketable stage for fresh consumption
- T4 = Removal of terminal head plus first two axillary heads at marketable stage for fresh consumption
- T5 = Removal of all axillary heads at marketable stage for fresh consumption
- T6 = Retain only terminal head with thinning of 50% flower stalk at the stage when flower buds begin to open and removal of all axillary heads at marketable stage for fresh consumption

Table 4: Comparison of various treatments with respect to seed yield, fresh yield, seed quality as well as gross income from the seed and fresh products.

Treatment	Yield (kg/ha)		Seed quality				Value of Products (Rs/ha)		Total Value (Rs/ha)
	Fresh yield	Seed yield	Germination %	1000 seed weight (g)	Vigor index I	Vigor index II	Fresh vegetable @ Rs. 25/kg***	Seed @ Rs. 800/kg***	
T1	0.0	842.0 bc	73	3.793 b	12.54	626.9	0	673600	673600
T2	0.0	1062.0 ab	74.5	3.810 b	12.63	640.7	0	849600	849600
T3	1285.0 bc	1148.0 a	75	3.885 a	13.76	674.5	32125	918400	950525
T4	1910.0 a	862.1 bc	74.5	3.880 a	13	663	47750	689680	737430
T5	929.8 c	720.0 c	73	3.830 b	12.99	653.9	23245	576000	599245
T6	1584.0 ab	904.0 abc	77.5	3.90 a	14.38	696.6	39600	723200	762800
LSD value	521.2**	241.0**	ns	0.0312**	ns	ns	-	-	-

Note: *** The value was calculated according to the prevailing wholesale price in the Narayangarh market during the production period.

** significant at 0.01 level of significance

ns - non significant

Values with the same letters are not significantly different at 1% (**) level by DMRT.

- T1 = Control (No removal of any heads)
- T2 = Removal of terminal head just after sprouting
- T3 = Removal of terminal head at marketable stage for fresh consumption
- T4 = Removal of terminal head plus first two axillary heads at marketable stage for fresh consumption
- T5 = Removal of all axillary heads at marketable stage for fresh consumption
- T6 = Retain only terminal head with thinning of 50% flower stalks at the stage when flower buds begin to open and removal of all axillary heads at marketable stage for fresh consumption

CONCLUSION

The research result revealed that terminal head removal had positive effect on yield and quality of broccoli seed. This might be due to the fact that by removal of terminal head several numbers of axillary heads were produced around the main stem and they were not so compact as terminal head and also got more space which decreased

competition among the flower stalks and thus produced more seeds. In case of control plants (without heads removal), axillary heads produced from the axil of the leaves and the flower stalks produced from terminal head were more compact which increase competition among the flower stalks for space, light and nutrition, thus normal development of seeds was hampered. Terminal heads removed were used as vegetable. This is an extra benefit for seed growers because of the nutritious green vegetable obtained with no extra cost besides seed. Removal of terminal head at marketable stage treatment gave highest return i.e. Rs. 950525 per hectare by selling the fresh vegetable as well as seed. Similarly, no significant difference was observed in quality parameters among the treatments expect in 1000 seed weight which was highest in T6 (thinning treatment) that was statistically similar with T3 (removal of terminal head at marketable stage). So, from this study, it can be concluded that T3 (removal of terminal head at marketable stage) proved to be the best profitable treatment to produce quality seed in the plain areas of Chitwan.

ACKNOWLEDGEMENTS

I feel pleasure to express our deep sense of gratitude to the Research Committee, Directorate of Research and Publication, IAAS, Rampur, Chitwan, for providing partial financial support to carry out this research. I am also equally thankful to all friends and staffs of horticulture department who cooperated to carry out this study.

REFERENCES

[1] Chatterjee, S. S. Cole crops, In: T. K. Bose and M. G. Som (eds.) Vegetable crops India. Naya Prokash, Calcutta. pp. 165-247, 1986.

[2] Devkota, F. R., Comparative pollination behaviour of Apis cerana and Apis mellifera L. on broccoli and their impact on seed production under Chitwan condition. Thesis, M. Sc. Ag., Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal (Abstract), 2000.

[3] Fahey, J. W., Y. Zhang and P. Talalay, Broccoli sprouts: an exceptionally rich source of inducers of enzymes that protect against chemical carcinogens. In: Proc. Natl. Acad. Sci. USA. Vol. 94, pp. 10367-10372, September 1997.

[4] Firoz, Z. A., M. M. U. Choudhury, A. K. Choudhury and A. F. M. E. Hoque, Effect of planting time and main curd removal on the seed production of broccoli in the hilly region. Bangladesh J. Agril. Res. 25(3): 499-504, 2000.

[5] Ghimire, A. J., M. R. Bhattarai and R. Khanal, Effect of removing terminal or axillary heads on the yield and quality of seed of broccoli cultivar Green Sprouting. PAC working paper no. 77. pp 1-7, 1993.

[6] Gray, A. R., Taxonomy and evolution of broccoli, Econ. Bot., 36: 397, 1982

[7] Lindsay, A.; D. J. Fink and A. Lindsay, The American Cancer Society Cookbook. Hearst Books, New York. Pp.269, 1988.

[8] Rangavajhyala, N, V. M. Ghorpade and S. S. Kadam, Broccoli. In: D. K. salunkhe and S. S. Kadam (eds.). Handbook of vegetable science and technology. Marcel Dekker Inc., 270 Madison, Avenue, New York, pp 337- 357, 1998.

[9] Rashid, M. M., Shabji biggyan. Bangla Academy, Dhaka, Bangladesh, Pp. 515, 1996.

Volume: 02 / Issue: 04 / 2023 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

[10] Reiley, E. H. and L. S. Jr. Carrol, Introductory horticulture. Delmar publisher Inc. Albany, New York, USA, Pp. 534, 1983.

[11] Sanders, D. C., Broccoli production. Department of Horticultural Science, College of Agriculture and Life Science, North Carolina State University, 1999.

[12] Shinohara, S. Cauliflower and broccoli. In: Shinohara Suteki (ed). Vegetable seed production technology of Japan., pp. 55-81, 1984.

[13] Sukthong, M., Effect of central flower cluster thinning on seed production of broccoli. Journal of Regional Education Center (REC), agricultural technology, 2. pp. 39-45, 1993.

[14] Sukthong, M., Effect of central flower cluster thinning on seed Viability and Yield of Broccoli. [online]. Available: www.ucce.ucdavis.edu/datastore. (retrieved: January 12, 2005), 1998.

[15] Thompson H. C. and W. C. Kelly, Vegetable crops (Fifth Edition). McGraw Hill Book Company, Inc., India, 1979.

[16] VDD, Nepalma tarkari bieu utpandan pustika (In Nepali). HMG/N, Ministry of Agriculture, Department of Horticulture, Vegetable Development Division and Fresh Vegetable and Seed Production Project/FAO, 1990.

[17] VDD, Study on management of foundation seed of vegetable crops in Nepal. HMG/N, Ministry of agriculture and co-operative, Department of Agriculture, Vegetable Development Division (VDD), Khumaltar, Lalitpur, 2000.

[18] VDD, Study on Market demand and supply situation of vegetables seeds in Nepal (second year). HMG/N, Ministry of agriculture and co- operative, Department of Agriculture, Vegetable Development Directorate [19] VDD, Khumaltar, Lalitpur, 2001.