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Effect of curd size on seed yield and quality of Cauliflower (*Brasicaoleraceae* var. *botrytis* L.)

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Abstract

A field experiment, to see the effect of curd size on seed quality and yield of cauliflower (*Brasica oleraceae* var. *botrytis* L.) using cultivar 'Hansa' was conducted at vegetable experimental area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad during 2016-2017. Five different head sizes were used as treatments comprising of T1 (Very small curd size 0-5 cm), T2 (small curd size 5-10 cm), T3 (medium curd size 10-15 cm), T4 (large curd size 15-20 cm), T5 (extra-large curd size 20-30 cm).Data for different seed yield and quality parameters was recorded and mean values were analyzed at a level of 5% probability. Maximum values for 1000 seed weight (3.82gm), Germination percentage (91.60%), Root length (5.78cm) ,Shoot length (8.32cm), Seedling length (14.10cm), Seedling fresh weight (0.45gm), Seedling dry weight (0.06gm) were recorded for T5 (extra-large curd size 20-30 cm).Electrical Conductivity of seeds (0.33 dsm) was recorded in case of T4 (large curd size 15-20 cm). Maximum values for Number of pods/Plant (408.80), Number of seeds per pod (12.60), Length of pod (6.48cm), Seed yield per plant (13.68gm), Seed yield (496.01 kg/ha-1) were recorded for T5 (extra-large curd size 20-30 cm). Significant difference between seed yield and quality of seed was noticed among varying size of curd of cauliflower. Extra-large and large curd size performed better than other treatments in terms of seed yield and quality of seed.

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Introduction

Seed production of Cole crop is profitable enterprise. In Cole crop seed production, Public and private sectors are playing critical role. For obtaining maximum seed yield and to set quality seed crop knowledge about economic importance and quality of seed is necessary. Profitable crop production is largely influenced by the quality of seed in cauliflower hence high quality seed is required for a better stand of crop. The progress has already been made by bringing more area under cauliflower cultivation and by paying attention towards the production of seed. Many of government and private sectors are now producing hybrid and good quality seeds. There are many factors affecting the quality and quantity of cauliflower seed viz uniformity, curds compactness and size of curd. Yield and quality of seed is directly affected by the size of curd.

Quality seed is prerequisite for high yield as Kanwar *et al.* (2010) reported that an increase of 25-40% in yield can be achieved by quality seed of certified varieties. Due to its nutritional value its demand throughout the year is high but production of cauliflower is low due to unavailability of quality seed, harsh climate, and poor management practices.
Cauliflower (*Brassica oleracea* var. *botrytis* L.) is an important vegetable among Cole crops. Cauliflower is best grown in cool temperature where plenty of sunlight is available. Moist soil is best for its growth and sandy soils are best with high organic matter. It thrives best at a day temperature of 21-29 ^{o}C. Long periods of sun exposure and hot weather can cause discoloration.

It is matured after 7-12 weeks of transplanting. Optimum time of sowing of seed and transplanting varies greatly which depend upon temperature requirement and varieties. Nursery can be produced on flat beds where soil is fertile, well drained and loose and seeds are shallow planted at about 0.5 cm inches. The best temperature for nursery growing is 18 ^{o}C and seedlings become ready within 25 to 35 days (Vincent *et al.,* 2017). Very low and very high temperature, both are lethal for its growth (Din *et al.*, 2007).

Curd size can affect the quality of seed as Kanwar *et al.* (2000) reported that 1000 seed weight, germination percentage and overall yield was increased as head compactness increased. Kanwar *et al.* (2001) also reported that with the increasing head size, an enhancement in early flowering, high percentage of germination and more seed yield was observed.

Keeping in view the trending facts, present study is undertaken to check if seed yield can be increased and seed quality can be improved by using varying curd sizes, To determine the selection of suitable curd size for enhanced seed production.

Material and methods

During the year 2016-2017, an experiment was conducted in field area of Institute of Horticultural Sciences, University of Agriculture, Faisalabad, to see the effect of curd size on seed yield and quality of Cauliflower. Seeds of cauliflower cv. (HANSA) were sown in field area and after 30 days when seedlings attained proper height they were transplanted in field.

Cauliflower curd size was considered as treatments and treatments comprises of, T_1 = Very small size curd (diameter 0-5 cm), T_2= Small size curd (diameter 5.1-10 cm)T_3 = Medium size curd (diameter 10.1-15 cm), T_4 = Large size curd (diameter 15.1-20 cm), T_5 = Extra-large size curd (diameter 20.1-30 cm.

The experiment was laid out according to Randomized Complete Block Design (RCBD) comprising of five treatments with three replications. Data on, Number of pods/Plant, Number of seeds per pod, Length of pod (cm), Seed yield per plant (gm), Seed yield (kg/ha^{-1}) was recorded.

1000 seed weight (gm)

1000 seeds were counted from the total seeds of each plant and were weighed with the help of weight balance.

Length of pod (cm)

Pods from the plants of each treatment were selected on random basis and their length was measured with the help of scale and average was calculated.

Seed yield per plant (gm)

Pods separated from plants of each treatment were threshed and their seeds were separated and then it was weighed with the help of weight balance.

Seed yield (kg/ha^{-1})

Seed yield per hectare was calculated from seed yield/plant. Firstly no. of plants/hectare was calculated by using following formula.

$$\text{No. of plants} = \frac{\text{Area}}{(\text{Plant} \times \text{Plant}) \times (\text{Row} \times \text{Row})}$$

Then seed yield per hectare can be calculated by using following formula

Seed yield per hectare = (seed yield/plant) × (No. of plants/ha).

Germination percentage

For calculating germination percentage 10 seeds of each curd size were placed on wet filter paper in petri dish. Filter paper was made wet by the addition of water which was 25 % of the total weight of the paper (AOSA), 1993.

This procedure was replicated three times for each treatment. After placing seeds on wet paper, petri dishes were placed at room temperature for 10 days and then germination percentage was calculated by using the following formula

$$\text{Germination percentage} = \frac{\text{No. of seeds germinated}}{\text{total no. of seeds}} \text{X } 100$$

From three reading of each curd size treatment average was calculated.

*Root, shoot and seedling length (cm***)**

Ten seedlings were selected from each treatments and their root, shoot and seedling length was calculated with the help of scale.

Seedling fresh weight (gm)

After measuring shoot and root length, each seedling was weighed using weight balance.

*Seedling dry weight (gm***)**

Seedlings were placed in oven at a temperature of 80 ^{o}C for 4 hours and the dry weight was calculated with the help of weight balance (Khulbe *et al.,* 2010).

Electrical Conductivity (dsm) of Seeds

EC of seeds was measured with the help of EC meter. 100 Weighed seed of each treatment was separated from the total seed and it was soaked in 100 ml of distilled water for 24 hours at room temperature. Then EC was calculated by dipping the probe of EC meter in that water after calibrating it with distilled water. Readings EC meter were observed from the digital display on EC meter (Mirdad *et al.,* 2006).

Results and discussion

Seed yield parameters

Regarding seed yield and contributing characteristics, a significant difference between all parameters was observed.

Maximum Number of pods/Plant (408.80) was observed under the treatment extra-large curds while minimum no. of pods/plant (141.20) was observed in case of very small curd size (Table 1).

Table 1. Effect of curd size on seed yield of cauliflower.

Treatments	Number of pods/Plant	Number of seeds/pod	Length of pod (cm)	Seed yield/plant (gm)	Seed yield ha^{-1} (kg)
T_1	144.20e	8.20d	4.40c	4.62d	167.51d
T_2	182.80d	9.00cd	5.14bc	6.20cd	224.80cd
T_3	241.80c	10.20bc	5.30b	7.74bc	280.64bc
T_4	301.80b	11.00ab	5.60ab	9.82b	356.05b
T_5	408.80a	12.60a	6.48a	13.68a	496.01a
LSD Value at 0.05	35.696	1.7609	0.8918	3.02	109.64

The reason behind that may be that extra-large curd size had more no. of stalks as compared to others and more heighted stalks which ultimately let them had more no. of pods per stalks as well as more no. of pods per plants and opposite to that very small curd had less heighted stalks and less no. of stalks ultimately contributing towards less no. of pods per plant The results are in conformity with (Singh, *et al.*, 2000; Jana, 2004).

Curd size significantly affected no. of seeds per pod and higher value (12.60) was observed in case of extra-large curds which is statistically at par with the value of Number of seeds per pod (11.00) which was observed for large curd, while minimum value was observed when seeds were produced from very small curd (8.20) which is statistically similar to value curd size (9.00) of small curd size (Table 1).

Difference in no. of seeds per pod may be due to the reason that extra-large and large curds produced more lengthy pods. Its vegetative growth was better than that of very small and small curds which produced less lengthy pods because of less vegetative growth. The results are in conformity with (Singh, *et al.*, 2000; Jana, 2004).

Table 2. Effect of curd size on seed quality cauliflower.

Treatments	1000-seed weight (gm)	Germination percentage (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (gm)	Seedling dry weight (gm)	EC of seeds
T_1	2.68d	84.60d	5.13bc	5.54d	10.67c	0.30d	0.04d	0.27c
T_2	3.04c	87.00cd	4.75d	6.22c	10.97c	0.30cd	0.04d	0.28c
T_3	3.09bc	88.40bc	5.23b	6.94b	12.12b	0.33bc	0.05c	0.29bc
T_4	3.35b	90.00ab	4.90cd	7.22b	12.18b	0.37b	0.05b	0.39a
T_5	3.82a	91.60a	5.78a	8.32a	14.10a	0.45a	0.06a	0.33b
LSD Value at 0.05	0.31	2.46	0.31	0.63	0.79	0.0345	0.003	0.04

Maximum Length of pod (6.48 cm) was observed under the treatment extra-large curd which is statistically similar to that of large curd size (5.60 cm) while minimum value for Length of pod was observed in very small curd (4.40 cm) which is statistically at par with small curd size (Table 1). The reason may be that extra-large and large curd was produced from healthier plants. Healthier plants utilized the photosynthates and accumulates more efficiently ultimately contributing to the increased length of pods. All the values are statistically similar due to the fact that less healthy plants had less no. of stalks and more open canopy helping sunlight to penetrate more properly and less competition between stalks and pods on same plants. The results are similar to the findings of (Mihov and Antonova, 2009).

In case of seed yield per plant, maximum value were observed (13.68 g) in case of extra-large. Minimum value for Seed yield per plant was observed when curd selected were very small (4.62 g) which is statistically at par with the value of Seed yield per plant observed in case of small curd size (6.20 g) (Table 1).

The reason behind the variation among treatments may be due to the fact that extra-large curd produced profuse stalks which allowed the plant to have more no. of pods per plant. Very small curd had less no. of stalks and on stalks there may be less no. of pods. Less no of pods caused a decrease in yield per plant for small and very small curd as compared to extra-large and large curd size treatments (Das *et al.,* 2000; Sukthong, 2008).

Seed yield per hectare elaborated that maximum Seed yield per hectare (496.01 kg/ha) was observed under the treatment when extra-large. Minimum value for Seed yield per plant was observed when curd selected were very small (167.51 kg/ha) which is statistically at par with the value of Seed yield per plant observed in case of small curd size (224.80 kg/ha) (Table 1). This may be due to the fact that large curd produced more stalks which allowed the plant to have more no. of pods per plant and ultimately increased the seed yield. Very small curd had less no. of pods causing decrease in yield per hectare as compared to extra-large and large curd size treatments (Gurusamy, 1999).

Seed quality parameters

Germination percentage and 1000-seed weight are main parameters contributing to the assessment of quality of a seed as the germination percentage provides a close idea of emergence if field conditions are ideal which is not possible in most cases. Still we can get an idea of viability of seed.

Maximum 1000 seed weight (3.82 g) was observed under the treatment when extra-large curd while the lowest value (2.68 g) was observed in case of small curd size (Table 3). The reason behind this could be that large and extra-large curd size is produced from the healthier plants and small and very small curds were produced by the less healthy ones. Healthier ones produced more vigorous seeds, have more size than that of seeds produced from the small and very small curd size. This result in confirmed by (Singh *et al.* 2005).

Comparison between the mean values of germination percentage elaborated that maximum germination percentage (91.60 %) was observed in extra-large curd which was statistically similar to germination percentage (90.00 %) observed in case of large curd while Minimum value for germination percentage was observed when curds were very small (84.60 %) which is statistically at par with the value of germination percentage (87.70 %) observed in case of small curd size (Table 2). More germination percentage observed in extra-large curd may be due to the fact that extra-large curd produced healthier and vigorous seeds due to proper utilization of nutrients and more no. of leaves available to produce food for plants. Less germination percentage in case of small and very small is due to less leaf area, less efficiency in utilization of nutrients. The results are in conformity with the findings of (Strydom, 1998).

Root length (5.78 cm) was observed in case of extra-large curd while minimum value for root length was observed when curds selected were small (4.75 cm) which is statistically at par with the value of root length observed in case of large curd size (4.90 cm). Similarly maximum shoot length (8.32 cm) and seedling length (14.10 cm) was recorded from seeds of extra-large curds while minimum values (5.54 cm) and (10.67 cm) were recorded in case of very small curd size (Table 1). Seedling length may differ due to the fact that seeds produced from large curds and extra-large curds were more vigorous as they had more quantity of stored food as endosperm and opposite to that seeds from small and very small curds were less vigorous and had less food stored. These results are confirmed as the findings of Kanwar *et al.* (2001) were same.

Maximum values for seedling fresh weight (0.45 g) and seedling dry weight (0.065 g) were observed in extra-large curd and Minimum values (0.30 g) and (0.04 g) were observed when curd selected were very small and both are statistically at par with the value of seedling fresh weight (0.30 g) and seedling dry weight (0.04 g) observed in case of small curd size (Table 2). This may be due to the reason that size of seedling from extra-large curd was lengthier than that of seedlings produced by very small and small curds. Also there may be more no. of leaves in lengthy seedlings as compared to less lengthy ones which ultimately contributed to an increase in fresh and dry weight of seedlings produced from the seeds collected from extra-large curds. Results are in agreement with (Roy *et al.,* 1997).

Comparison between the mean values of electrical conductivity of seeds elaborated that maximum Electrical conductivity of seed (0.39 dsm) was observed under the treatment when large curd was selected for seed production followed by (0.33 dsm) observed in case of extra-large curd size when selected for seed production which is statistically at par with the Electrical conductivity value of medium curd (0.29 dsm). Minimum value for Electrical conductivity of seed was observed when curd selected were very small (0.27 dsm) which is statistically at par with the value of Electrical conductivity of seed observed in case of small curd size (0.28 dsm). The reason behind the difference in Electrical conductivity of seed is due the effect of seed coat, seed coat if hard which is in case of very small and small curd size allowed less quantity of leachates to imbibe through seed to water in which seeds were placed hence had a

less value of Electrical conductivity as compared to the large and extra-large curds which produced seed having less hard coat and allowed more leachates to imbibe through seed coat into water in which seeds were placed and had a higher value of Electrical conductivity of seed. The results are similar to the findings of (Mirdad *et al.,* 2006)

Conclusion

Results of this study revealed that curd size has significant effect on seed yield and quality of cauliflower. Among all curd size, extra-large curd size and large curd size when replanted for seed production performed well. In extra-large and large curd size improved pod length, number of pods per plant, number of seed per pod, seed yield per plant, yield per hectare, 1000-grains weight were observed. It also enhanced seed vigour, germination percentage and electrical conductivity of seeds. So, it can be concluded that extra-large curd and large curd size are more promising for getting good yield and better quality of cauliflower seeds.

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