IMPACT OF DIFFERENT PLANT SPACING AND NITROGEN LEVELS ON THE GROWTH AND YIELD OF CAULIFLOWER (*Brassica oleracea*)

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***ABSTRACT*:** *The study on the influence of different spacing and nitrogen levels on growth and yield of cauliflower was conducted to evaluate some growth and yield parameter such as survival percentage, days to curd initiation from transplanting, number of leaves per plant, height (cm), diameter of curd (cm), average curd weight (gm), total curd weight (kg ha^{-1}) and average number of days to curd harvest. The results showed that nitrogen (80 kg ha^{-1}) and plant spacing (55 cm) has significant effect on all parameters. However maximum survival percentage (81.00), number of leaves (23.00), plant height (52.67 cm), curd diameter (30.89 cm), curd weight (1005.56 gm), total curd weight (4506.54 kg) and minimum number of days to curd initiation (113.33) and days to curd harvest (139.44) was obtained from 80 kg ha^{-1} of nitrogen whereas minimum survival percentage (79.45), number of leaves (18.89), plant height (50.22 cm), curd diameter (28.56 cm), curd weight (900 gm), total curd weight (4070.03 kg) and maximum number of days to curd initiation (116.67) and days to curd harvest (143) was obtained from control (0 kg nitrogen). Maximum survival percentage (80.50), number of leaves (22.25), plant height (52 cm), curd diameter (30.08 cm), curd weight (975 gm), total curd weight (4376.94 kg) and minimum number of days to curd initiation (114.08) and days to curd harvest (40.25) was obtained from 55 cm plant spacing whereas minimum survival percentage (79.08), number of leaves (19.83), plant height (50.33 cm), curd diameter (28.25 cm), curd weight (883.33 gm), total curd weight (4105.30 kg) and maximum number of days to curd initiation (116.58) and days to curd harvest (142.33) was obtained from 35 cm plant spacing. Application of over dose nitrogenous fertilizer should reduce curd yield of cauliflower because it enhance vegetative production. Plant spacing (55 cm) and nitrogenous fertilizer (80 kg ha-1) produces best cauliflower yield.*

Key words: Cauliflower,Curd initiation, Nitrogen levels, Row spacing and Yield

INTRODUCTION

Cauliflower (*B.oleraceae var. Botrytis*) belongs to the family cruciferae.. The cauliflower is a high-value crop especially in green stage, however little is known the planting time, different nutrients and plant spacing. Especially in Netherlands, the green cauliflower quality is poor in summer months while in fall it quality becomes improve [1]. For cultivar × spacing trial, Csizinszky [2] known that 'Alverda' green cauliflower curd size was found largest at 46 cm in-row spacing. Islam *et al*. Others [3] investigated the maximum average yield were obtained from 45x10 cm plant spacing, which was strongly followed by 45x20 cm plant spacing in turmeric. Oad *et al*. [4] reported that 45 cm plant spacing as the mainly successful plant spacing for getting the maximum production of cotton, while the narrow plant spacing could not record satisfactory plant character including ginning out-turn and **seed cotton yield**. Mahmood [5] reported that the transplanting of potato seeds with 50x5 cm spacing produced the maximum yield. Karaaslan *et al*. Authors in [6] suggested that decreasing row spacing increased the yield per hectare of sesame. The aim of this work was to get insight into the processes that determine yield and the use of fertilizer N, the effect of N fertilization on several growth parameters was determined.

MATERIALS AND METHODS

To study the effect of different nitrogen levels and plant spacing on growth and yield of cauliflower a trail was carried out at Horticultural Research Farm Malakandher, The University of Agriculture, Peshawar during the year 2008 and 2009 (in winter season).

The experiment was conducted in Randomized Complete Block Design with two factors factorial arrangement with three replications. For this different Nitrogen levels (0, 40, 80, 120 kg.ha^{-1}) were applied to the cauliflower cultivated keeping the row spacing of 35, 45 and 55 cm.

Chemical characterization of experimental field was done before establishing the trial which exposed Electric conductivity (70.3µ s /cm), Organic matter (1.76 %), Nitrogen (9.81 mg kg^{-1}), P_2O_5 (0.08 mg kg^{-1}), K_2O (40.3 mg kg^{-1}) and pH (8.5).

Standard agronomic practices including hoeing and weeding was applied. Recommended doses of P and K was applied.

Percent Survival (%)

Percent survival following formula at the end of the growing season was calculated.

$$\text{Survival percentage (\%)} = \frac{Number\ of\ plants\ survived}{Total\ number\ of\ plants\ sown} \times 100$$

Plant height (cm)

Plant height and average in each copy of the data randomly selected from each treatment plant 5 plants at the tip of the plant was based was recorded.

Average number of leaves plant^{-1}

For the average number of leaves plant^{-1}, five randomly selected plants were counted for each treatment in each replication and their average was calculated.

Days to curd initiation from transplanting

Days from the date of transplantation means a curd every copy of each treatment was calculated.

Average number of days to curd harvest

The data were counted by the days from curd initiation till harvest.

Average diameter of curd (cm)

Curd diameter of 5 randomly selected plants for each copy of a treatment was measured with a tape measure and the average was calculated.

Average curd weight (g)

For curd weight plant^{-1}, the curd weight of five randomly selected plants was measured with help of digital balance from each treatment in all replications and means were computed.

Total curd yield (kg ha^{-1})

The weight of harvested curds was measured with the help of electronic balance to calculate total yield (kg ha^{-1}).

RESULTS AND DISCUSSIONS

Survival percentage

The mean data revealed that the maximum survival percentage (81.00 %) was obtained from nitrogen level of 80 ha^{-1} while the minimum survival percentage (79.22 %) was recorded in 120 kg ha^{-1}. Plant spacing has also significant effect, maximum survival percentage (80.50 %) was obtained at plant spacing 55 cm followed by plant spacing 45 cm (79.67 %) while the minimum (79.08 %) survival percentage was obtained from 35 cm plant spacing. Their interaction has also significant effect, maximum survival percentage (82.67 %) has obtained from 80 kg ha^{-1} of nitrogen and 55 cm plant spacing while the minimum survival percentage (78.00 %) has recorded from 40 kg ha^{-1} of nitrogen and 35 cm plant spacing. Since the number of plant with 55 cm spacing is less as compared to 35 cm spacing enhanced plant survival can be attributed to greater availability of nutrients, sunlight, water and CO_2 in the 55 cm plant spacing, which result the superior plant survived. These results are agreement with Muhammad *et al.*Others [7], reported that nitrogen level improved the survival percentage three varieties of onion.

Plant height (cm)

Minimum plant height (50.22 cm) was recorded in control and maximum values of plant height (52.67 cm) means the ha-1 (50.89) won the 120 kg ha-1 of nitrogen was 80 kg nitrogen level was recorded. Plant spacing has also significant effect, maximum plant height (52.00) was obtained at plant spacing 55 cm while minimum (50.33) days to plant height was obtained from 35 cm plant spacing. Closer spacing among the plants resulted in lower plants height due to the competition of nutrients, moisture and light among the plants. This might be the reason that by increasing the spacing up to a certain limit had increased the plant height of the cauliflower plant. Nitrogen promotes vegetative growth, by increasing as well as decreasing of nitrogen fertilizer from specific dose (80 kg ha^{-1}) can also be effected on plant height of cauliflower.

Average number of leaves plant^{-1}

The given data revealed that maximum number of leaves plant^{-1} (23.00) was recorded at nitrogen level of 80 kg ha^{-1} followed by (22.44) was obtained from 120 kg ha^{-1} of nitrogen while the minimum number of leaves plant^{-1} (18.88) was recorded in control. Plant spacing has also significant effect, maximum number of leaf plant^{-1} (22.250) was obtained at plant spacing 55 cm while minimum (19.83) days to number of leaves plant^{-1} was obtained from 35 cm plant spacing. Nitrogen promotes vegetative growth, by increasing as well as decreasing of nitrogen fertilizer from specific dose (80 kg ha^{-1}) can be effected on number of leaves of cauliflower. Spacing has also effected on the number of leaves of cauliflower, decrease spacing have minimum number of leaves while increase spacing have maximum number of leaves of cauliflower.

Days to curd initiation

Maximum days to curd initiation (117.11) was observed at 120 kg N ha^{-1} followed by (116.67) was obtained from control while minimum days to curd initiation (113.33) was recorded in 80 kg ha^{-1} of nitrogen. Plant spacing has also significant effect, maximum days to curd initiation (116.58) was obtained at plant spacing 35 cm while minimum (114.08) days to curd initiation was obtained from 55 cm plant spacing. Nitrogen promote vegetative growth, by increasing as well as decreasing of nitrogen fertilizer can delay curd initiation while at optimum level of nitrogen fertilizer can promoted early curd initiation of cauliflower. Spacing has also effect on the curd initiation of cauliflower, decrease spacing can delay curd initiation by contrast increase spacing promote early curd initiation.

Average number of days to curd harvest

Means values showing that maximum number of days to curd harvest(143.00) was recorded from control plants followed by (142.78) was obtained from 40 kg ha^{-1} nitrogen while teminimum number of days to curd harvest(136.89) was recorded in 120 kg ha^{-1} nitrogen. Plant spacing has also significant effect, maximum number of days to curd harvest(142.33) was obtained at plant spacing 35 cm while minimum (139.00) number of days to curd harvest was obtained from 45 cm plant spacing. Increasing of nitrogen can early maturity of cauliflower curd while decrease nitrogen can delayed curd maturity. Spacing has also effect on days to curd harvest, less spacing can take maximum number of days to harvest while greater spacing can take minimum number of days to curd harvest.

Average curd diameter(cm)

Maximum curd diameter (30.89 cm) was recorded at nitrogen level of 80 kg ha^{-1} followed by (29.11) was obtained from control while minimum curd diameter (28.44 cm) was recorded in 120 kg ha^{-1} nitrogen. Plant spacing has also significant effect, maximum curd diameter (30.08) was obtained at plant spacing 55 cm while minimum (28.25) days to plant height was obtained from 35 cm curd diameter. These findings agree with Bjelic [8] proved that curd diameter was mainly affected by nitrogen and the weight registered was up to 80 kg ha^{-1}. However increased potassium and phosphorus amounts have non-significantly effected on curd diameter.

Average curd weight (g)

Mean values revealed that maximum curd weight (1005.56) was recorded at nitrogen level of 80 kg ha^{-1} followed by (930.00) was obtained from 120 kg ha^{-1} nitrogen while minimum curd weight (883.33) was recorded in 40 kg ha^{-1} nitrogen. Plant spacing has also significant effect, maximum curd weight (975.00) was obtained at plant spacing 55 cm while minimum (883.33) days to curd weight was obtained from 35 cm curd weight. Curd better plant growth and development for close spacing nutrients, sunlight and space

to get off to shrink due to the poor results showed. Similar results

Table-I. The influence of Nitrogen levels and row spacing on the Percent survival, plant height, Number of leaves plant^{-1}, Days to curd initiation, Days to curd harvest, Curd diameter, Curd weight and Yield of the Cauliflower.

Nitrogen Levels (kg.ha^{-1})	Percent Survival (%)	Plant height (cm)	Number of leaves plant^{-1}	Days to curd initiation	Days to curd harvest	Curd diameter (cm)	Curd weight (g)	Yield Kg.ha^{-1}
0	79.45 b	50.22 b	18.89 b	116.67 a	143.00 a	28.56 b	900.00 b	4070.03 b
40	79.33 b	50.67 b	20.22 b	113.89 b	142.78 a	29.11 b	883.33 b	4192.34 b
80	81.00 a	52.67 a	23.00 a	113.33 b	139.444 b	30.89 a	1005.56 a	4506.54 a
120	79.22 b	50.89 a	22.444 a	117.11 a	136.89 b	28.44 b	930.00 b	4045.68 b
LSD	0.88	1.50	2.20	2.00	3.84	1.53	71.50	260.60
Spacing(cm) 35	79.08 b	50.33 b	19.83 b	116.58 a	142.33 a	28.25 b	883.33 b	4105.30 b
45	79.67 b	51.00 ab	21.33 ab	115.08 ab	139.00 b	29.42 ab	930.83 ab	4128.70 b
55	80.50 a	52.00 a	22.25 a	114.08 b	140.25 ab	30.08 a	975.00 a	4376.94 a
LSD	0.76	1.30	1.90	1.73	2.72	1.33	61.92	225.70
N X S	*	NS	NS	NS	NS	NS	NS	NS

The interation between Nitrogen levels and row spacing for plant survival (%) of cualiflower arise significant. The interation between them (N X S) is presented graphically in figure 1.

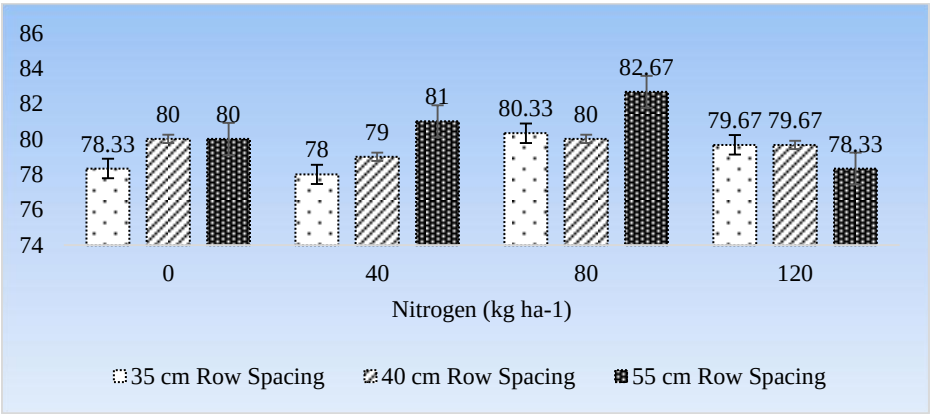

Fig 1.Graphical representation of N × S of Percent survival of Cauliflower.

were quoted by Oad *et al.*Others[4], who reported that narrow plant spacing could not record satisfactory plant characters.

Total Curd Yield (kg ha^{-1})

According to mean values maximum curd weight (4506.54) was recorded at a nitrogen level of 80 kg ha^{-1} followed by (4192.34) was obtained from 40 kg ha^{-1} nitrogen while minimum curd weight (4045.68) was recorded in 120 kg ha^{-1} nitrogen. Plant spacing has also significant effect, maximum curd weight (4376.94) was obtained at plant spacing 55 cm while minimumizing(4105.30) days to curd weight was obtained from 35 cm curd weight. The greater availability of nutrients, light and water uptake with wider space of 55 cm and optimum dose of nitrogen (80 kg ha^{-1}) might be the possible reason for the increment of cauliflower curd weight. These findings also agree with Markovic *et al.*[9], reported that yield of cauliflower was raised at increasing of nitrogen level.

CONCLUSIONS

Plant spacing (55 cm) and nitrogenous fertilizer (80 kg ha^{-1}) produces best cauliflower yield. Application of over dose nitrogenous fertilizer should reduce curd yield of cauliflower because it enhances vegetative production.

RECOMMENDATIONS

Transplant the plants at optimum spacing (55 cm) for best weight curd production. Nitrogenous fertilizer (80 kg ha^{-1}) should be used for best curd production.

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