Influence of spacing on yield, quality and economics of watermelon

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DOI: https://doi.org/10.22271/chemi.2020.v8.i6ab.11052

Abstract
An experiment entitled “Influence of spacing on yield, quality and economics of watermelon” was undertaken at Instructional farm department of vegetable science college of horticulture Dr. PDKV, Akola during summer season of 2018-2019 to study the influence of spacing on yield quality and economics of watermelon. The experiment was laid out in Randomized Block Design (RBD) with four replications and five treatments viz. T₁ (0.45 × 2.0 m), T₂ (0.60 m × 2.0 m), T₃ (0.75 m × 2.0 m), T₄ (0.90 m × 2.0 m) and T₅ (1.0 m × 2.0 m). As regard to yield parameter T₅ (1.0 m × 2.0 m) was found superior in respect of days required for edible maturity, number of fruits plant⁻¹, average fruit weight and fruit yield kg plant⁻¹. While yield kg plot⁻¹ and yield ha⁻¹ were found maximum in treatment T₁ (0.45 × 2.0 m). In respect of quality parameters, treatment T₃ (1.0 × 2.0 m) recorded maximum fruit diameter, fruit length, TSS Brix, reducing sugar, non-reducing and total sugar percent. Highest gross, net monetary returns and B:C ratio were obtained with treatment T₁ (0.45 × 2.0 m). Therefore, treatment T₁ (0.45 × 2.0 m) was found to be most remunerative considering B:C ratio.

Keywords: Watermelon, Citrullus lanatus, plant spacing, yield, quality and B:C ratio

Introduction
Watermelon (Citrullus lanatus thumb.) is one of the important vegetables crop grown extensively in India and in tropical and sub tropical countries of Asia and Africa. Watermelon (Citrullus lanatus) is believed to have originated in Africa and spread to other parts of world. Global area under watermelon cultivation is 3,477,285 ha with annual production of 118,413,465 tons. (FAOSTAT 2017). In India current status of area is 100.88 mha with production 2479.71 MT. In India, Uttar Pradesh is first in area 13.07 mha and production is 588.54 MT and Maharashtra is sixth in number with area 6.12 mha and production is 176.31MT (NHB Database 2017-18).

Watermelon has high nutritive value, rich in vitamin ‘C’ which is good for health, low in sugar and calories because of high percent of water. A watermelon is a type of edible fruit with 92% water, 7.55 Carbohydrates (g), 30 Calories (kcal), 0.62 Protein (g) and other essential minerals. Watermelon is rich in caretenoids. Caretenoides viz. lycopene, phytofluence, phytoten, betacarotene, lutein and neurosporene. Lycopene makes up the majority of the caretenoides in watermelon. The caretenoid content varies depending on the variety of the watermelon. Caretenoids have antioxidant activity, free radical scavenging property. Lycopene may also reduce risks of cardiovascular disease. Watermelon seeds are excellent sources of protein (essential and non-essential amino acids) and oil. Watermelon seed is about 35% protein, 50% dietary fibre. Watermelon seed is also rich in micro and macro - nutrients such as magnesium, calcium, potassium, iron, phosphorous, zinc, etc.

Watermelon varies in shape, from globular to oblong. External rind colour varies from light to dark green and may be solid, striped or marbled. The pulp colour of most commercial varieties is red. It has a very thick and hard rind, with a fleshy centre. Watermelons have very high water content, which make them extremely refreshing. Especially during summers. At the same time, they are low in calories and have almost no fats, making them one of the healthiest fruits.

Crop growth is largely influenced by spacing. Evidence suggested that, spacing affect the yield quality and thereby economics of watermelon. Shorter internodes, thinner branches without epical dominance, fruit setting and tertiary branches were all affected by spacing.
Yield and quality parameters are under the influence of spacing. Measurable difference among plants is visible only when plants develop enough and compete for nutrients. Also, the vine length, diameter, number of leaves and number of branches linearly increased with increased in spacing (Dean et al. 2011) [8].

Materials and Methods
An experiment entitled “Influence of spacing on yield, quality and economics of watermelon” was undertaken at Instructional farm department of vegetable science college of horticulture Dr. PDKV, Akola during summer season of 2018-2019. The experiment was laid out in randomized block design with four replications on medium black soil with uniform in texture, colour and having good drainage. The treatments constituted of five different plant spacings viz. T1 (0.45 × 2.0 m), T2 (0.60 m × 2.0 m), T3 (0.75 m × 2.0 m), T4 (0.90 m × 2.0 m) and T5 (1.0 m × 2.0 m). Variety of watermelon was planted on 9 th January 2019. Farm yard manure was applied 20 tones per hectare and N:P:K 200:100:100 kg/ha, was applied thoroughly the cropping period in split applications. The plants were grown randomly in each replication in a total of 20 plots of 10 m × 1.0 m. All the observations of growth and yield characters were taken monthly from 30,60,90 at last harvest days after planting. The harvested watermelons were picked up and were separated and statistically analysed.

Results and Discussion
The result of effect of spacing on yield, quality and economics of watermelon (Citrullus lanatus Thumb.) are presented in Table 1, 2 and 3.

The days required for edible maturity (72.22) was found to be superior among all the treatment in spacing T5 (1.0 m × 2.0 m) and statistically found at par with (73.32) and (75.50) in treatment T4 (0.90 m × 2.0 m) and treatment T2 (0.60 m × 2.0 m).

**Table 1:** Effect of spacing on yield of watermelon

| Treatments | Days required for edible maturity | Number of fruits per plant | Average fruit weight (kg) | Fruit yield (Kg/plant) | Fruit yield per hectare (tons) |
|------------|----------------------------------|---------------------------|--------------------------|------------------------|-------------------------------|
| T1 - 0.45 m × 2.0 m | 77.00 | 2.91 | 2.47 | 6.74 | 74.89 |
| T2 - 0.60 m × 2.0 m | 75.50 | 2.77 | 2.55 | 7.57 | 63.08 |
| T3 - 0.75 m × 2.0 m | 78.00 | 2.95 | 2.80 | 8.36 | 55.69 |
| T4 - 0.90 m × 2.0 m | 73.32 | 3.00 | 3.15 | 9.55 | 53.05 |
| T5 - 1.0 m × 2.0 m | 72.22 | 3.06 | 3.30 | 10.09 | 50.46 |

SE(m)±

CD at 5 %

3.36 | 0.23 | 0.51 | 1.63 | 16.04 |

The maximum fruit diameter (15.12 cm) was recorded in the treatment T2 (1.0 m × 2.0 m), which was statistically found at par with (15.07 cm) and (14.95 cm) treatment T4 (0.90 m × 2.0 m) and T5 (0.75 m × 2.0 m). More reducing sugar was obtained from widely spaced than closely spaced plant. Similar results were also reported by Tuncer et al. (2014) [8] in fodder watermelon and Sharma et al. (2018) [7] in cucumber.

Reducing sugar (3.34%) was maximum in the treatment T3 (1.0 m × 2.0 m), which was statistically found at par with (3.24%) and (3.16%) by treatment T4 (0.90 m × 2.0 m) and T5 (0.75 m × 2.0 m).more reducing sugar was obtained from widely spaced than closely spaced plant due to better translocation and accumulation of nutrients. These results are in conformity with the findings of Siva et al. (2018) [8] in pointed gourd.

Maximum number of fruits per plant (3.06) were recorded in the treatment T5 (1.0 m × 2.0 m), which was statistically found at par with (3.00) and (2.95) treatment T4 (0.90 m × 2.0 m) and treatment T3 (0.75 m × 2.0 m). The results revealed that, wider spacing provides larger area for development of a plant as well as possibility for more lush growth and development of fruit full branches due to less competition for nutrients, water and light Tuncer et al. (2014) [8], in fodder watermelon.

Maximum average fruit weight (3.30) was recorded in the treatment T1 (1.0 m × 2.0 m), which was statistically found at par with (3.15) and (2.80) treatment T4 (0.90 m × 2.0 m) and treatment T3 (0.75 m × 2.0 m). It is well evident from the present findings that, in wider spacing the plant attained more length and branches to accommodate the fruits having larger size. More over the wider spacing also provided more space to the developing fruits to grow into a bigger size. These results are supported by the findings of Maynard and Scott (1998), Kultar et al. (2001) [6] in watermelon.

Maximum fruit yield kg per plant (10.09 kg) was recorded in the treatment T1 (1.0 m × 2.0 m) which was statistically found at par with (9.55 kg) treatment T4 (0.60 m × 2.0 m). As spacing increased, fruit yield per plant also increased probably because wider spacing created less inter plant competition. These findings are in line with Kultar et al. (2001) [6] in muskmelon.

Maximum fruit yield per hectare (74.89 t) was recorded in the treatment T1 (0.45 m × 2.0 m) which was statistically found at par with (63.08 t) in treatment T2 (0.60 m × 2.0 m). The results revealed that higher number of plants under closer spacing clearly demonstrated advantage in fruit yield per hectare as compared to wider spacing. Similarly, results were reported by Adlan et al. (2018) [1] in watermelon.
The data presented in table 3, showed that, the highest gross monetary return (524258.00 Rs/ha), net monetary return (378884.42 Rs/ha) and net return (300791.42 Rs/ha) treatment T4 (0.45 m × 2.0 m). But the highest benefit cost ratio (3.60) was recorded in T5 (0.45 m × 2.0 m) which was followed by gross return (441567.00Rs/ha) and net return (300791.42 Rs/ha) treatment T2 (0.60 m × 2.0 m). The highest benefit cost ratio (3.60) was recorded in T5 (0.45 m × 2.0 m). Higher number of plants under closer spacing might have resulted in increased yields. The results of the present investigation are in agreement with Ban et al. (2011) in watermelon.

**Conclusion**

On the basis of present findings, it can be concluded that, spacing influenced yield, quality and economics of watermelon. Regarding yield parameters watermelon days required for edible maturity, Number of fruits per plant, average fruit weight and fruit yield per plant were superior in treatment T5 - 1.0 m × 2.0 m. While, fruit yield per hectare was found maximum in treatment T1 – 0.45 m × 2.0 m. With respect to the quality parameters viz., fruit diameter, fruit length, TSS, reducing sugar (%), non reducing sugar (%) and Total sugar (%) were found to be maximum in spacing 1.0 m × 2.0 m. Considering the economics, the highest net monetary return and the highest B:C ratio were obtained with spacing of 0.45 m × 2.0 m and thus treatment T1 (0.45 m × 2.0 m) was found to be more remunerative.

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### Table 2: Effect of spacing quality on watermelon

| Treatments | Fruit diameter (cm) | Fruit length (cm) | TSS °Brix | Reducing Sugar (%) | Non-Reducing sugar (%) | Total sugar (%) |
|------------|---------------------|-------------------|-----------|--------------------|------------------------|----------------|
| T1 0.45 m × 2.0 m | 14.35 | 26.99 | 9.92 | 2.93 | 3.99 | 6.92 |
| T2 0.60 m × 2.0 m | 14.62 | 27.59 | 10.05 | 3.11 | 4.02 | 7.13 |
| T3 0.75 m × 2.0 m | 14.95 | 28.09 | 10.13 | 3.16 | 4.28 | 7.45 |
| T4 0.90 m × 2.0 m | 15.07 | 29.15 | 10.98 | 3.24 | 4.40 | 7.63 |
| T5 1.0 m × 2.0 m | 15.12 | 29.33 | 11.17 | 3.34 | 4.52 | 7.85 |
| CD at 5 % | 0.14 | 0.37 | 0.13 | 0.07 | 0.09 | 0.04 |

### Table 3: Economics of watermelon as influenced by spacing

| Treatments | Yield per hectare (tons) | Cost of cultivation | Gross monetary return | Net monetary return | B : C ratio |
|------------|--------------------------|---------------------|-----------------------|---------------------|------------|
| T1 0.45 m × 2.0 m | 74.89 | 145373.58 | 524258.00 | 378884.42 | 3.60 |
| T2 0.60 m × 2.0 m | 63.08 | 140775.58 | 441567.00 | 300791.42 | 3.13 |
| T3 0.75 m × 2.0 m | 55.69 | 138179.58 | 389858.00 | 251678.42 | 2.82 |
| T4 0.90 m × 2.0 m | 53.05 | 135583.58 | 371350.00 | 235766.42 | 2.73 |
| T5 1.0 m × 2.0 m | 50.46 | 133383.58 | 353241.00 | 219857.42 | 2.64 |

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