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**Praveen Kumar Shukla**

M.Sc. Scholar, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

**Rajesh Singh**

Assistant Professor, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

## Effect of date of sowing and spacing on growth, forage yield and quality of cluster bean (*Cyamopsis tetragonoloba* L.)

**Praveen Kumar Shukla and Rajesh Singh**

### Abstract

A field experiment was conducted during Kharif season 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.7). The treatment consisted of different Date of Sowing (15 June, 1 July, 15 July) and Spacing (30cm x 20cm), (40cm x 20cm), 50x20(cm<sup>2</sup>). There were nine treatments which replicated thrice. The experiment was laid out in Randomized Block Design. The result showed that there were significant increase in growth and Forage yield parameters viz., plant height (98.3 cm), number of branch plant-1 (19.1), Dry weight (15.5 g), and CGR (24.7 g/m<sup>2</sup>/day), RGR(0.05 g/g/day) and yield and yield attributes viz., Green Fresh yield (20.6 t/ha) and Hay yield (5.8 t/ha) and Crude Protein Content (17.4%), Crude Fiber Content (22.7%) were recorded higher with T<sub>5</sub> (40cm x 20cm) +1 July. However maximum net returns (₹44760 /ha), gross return (₹ 72500 /ha) and B:C ratio (1.7) were also recorded in this treatment.

**Keywords:** Cluster bean, date of sowing, spacing, growth, forage yield and quality

### Introduction

Cluster bean (*Cyamopsis tetragonoloba* L.) crop with a chromosome number of  $2n=2x=14$  which is popularly known as guar, Chavli Kayi, Guari, Khutti. It is a self-pollinated crop belongs to family Fabaceae. The guar plant produces a cluster of flowers and pods, therefore, it is known as cluster bean. It is a drought hardy and deep rooted legumes crop grown for feed, fodder, green manure and vegetable purpose. Being a legume crop, it has the capacity to fix atmospheric nitrogen by its effective root nodules. It is generally 50-100 cm tall and bears 4 to 10 branches (branch type). However, non-branch type varieties have main stem only, which is heavily clustered with pods (Sunil *et al.*, 2018). The livestock is the major component of agricultural system in Pakistan and 53.2% of agricultural GDP is contributed by livestock. It is referred as "live bank" for village families and 35 million people from rural area are directly or indirectly dependent on livestock. The availability of adequate forage material with better nutritive profile is prerequisite for achieving the potential production of animals. The prevailing feed stuff is deficient in energy (26%) and protein (38%). The cluster bean is a bushy legume which occupies a major portion of moisture deficient areas of the sub-continent. Its principal uses include green manuring, grains and cattle feed. It can a bridge the gap between forage supply and demand in drought prone areas for its deeper root system and reduced transpiration rate. Pakistan ranks 2nd among the cluster bean producing countries of the world. It is grown on area of (154.8) ha with an average green forage yield (15 t/ha) which is far less than other cluster bean growing countries. The legume cultivation is restricted to marginal lands without application of any synthetic fertilizer. The cluster bean is a bushy legume which occupies a major portion of moisture deficient areas of the sub-continent. Its principal uses include green manuring, grains and cattle feed (Douglas, 2005). It can a bridge the gap between forage supply and demand in drought prone areas for its deeper root system and reduced transpiration rate (Paleg and Aspinal, 1981). Pakistan ranks 2nd among the cluster bean producing countries of the world. It is grown on area of (154.8) ha (GoP, 2009) with an average green forage yield (15 t/ha) which is far less than other cluster bean growing countries (Anonymous, 2008). The legume cultivation is restricted to marginal lands without application of any synthetic fertilizer. Cluster bean plants are used as shade for ginger and turmeric crops. Not only that, it is commonly used as a cover crop and green manuring crop. The whole seeds or splits are exported. For medicinal uses, green leaves are taken to cure night- blindness.

**Corresponding Author:**

**Praveen Kumar Shukla**

M.Sc. Scholar, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Seeds are used as a chemotherapy and other agent against small pox. Boiled cluster bean seeds are used as a poultice on enlarged livers; head swellings and on swellings due to broken bones. Seeds are also used as a laxative (Arora, 1979) [6]. Cluster bean is cultivated in arid and semi-arid areas of about 23.30 million hectare in our country producing 1.22 million tone of cluster bean with productivity of 584 kg/ha, Anonymous (2014) [4]. Rajasthan, Gujarat, Haryana, Uttar Pradesh and Punjab are known to be leading states for cultivation of this crop. Rajasthan is the largest Cluster bean producing states in the world as it dominates the Indian production scenario contributing to around 4.2 lakh tons *i.e.* over 70% of the total production in India. However, its productivity is low due to uneven and erratic distribution of rainfall in these areas as well as incidence of pests and diseases. It is cultivated in 3.18 lakh hectares in Gujarat with 1.91 lakh tone production with productivity of 602 kg ha<sup>-1</sup>. (Anonymous., 2015-16) [5].

### Materials and Methods

The present investigation was carried out during *khariif*, 2020 at Crop Research Farm, Department of Agronomy Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh. The Research Farm is situated geographically at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level. Cluster bean with Agaita Guara-112 variety. The experimentation put down in Randomized Block Design which containing of ten treatments with T1-(30cm x 20cm) +15 June, T2 -(40cm x 20cm) +15 June, T3 -(50cm x 20cm) +15 June, T4 -(30cm x 20cm) +1 July, T5- (40cm x 20cm) +1 July, T6- (50cm x 20cm) +1 July, T7 -(30cm x 20cm) +15 July, T8- (40cm x 20cm) +15 July, T9- (50cm x 20cm) +15 July, were replicated thrice.

The experimental site was uniform in topography The experimental site was uniform in topography and sandy loam in texture, basal in soil reaction (pH 7.2), low in available carbon (0.35%), medium available N (203.7 kg/ha), higher available P (7.2 kg/ha) and medium available K (100 kg/ha). Nutrient sources were Urea, DAP and Mop to fulfill the requirement of Phosphorus, phosphorous and potassium. The used fertilizers (20:40:20 N:P:K kg/ha were applied as basal at the time of seeding. Twelve days after the sowing thinning and gap filling was done and irrigation given at frequent intervals. In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several Forage yield parameters were recorded those parameters are growth parameters, plant height, branches per plant, plant dry weight are recorded. The yield parameters like Fresh yield and Hay yield, recorded. The quality parameters like Crude Protein content (%) and Crude Fiber content (%) recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez and Gomez 1984) [15].

### Results and Discussion

#### Influence of date of sowing and spacing on plant height in cluster bean

Data in Table 1, tabulated the plant height (cm) of cluster bean and there was increasing in crop age plant height was improved with the advancement of experimentation. The plant elevation was significantly higher in all different growth intervals with treatment six with the applications of (50cm x 20cm) +1 July. At harvest, extreme plant elevation (98.3 cm) was noted by the treatment six with the applications of (50cm

x 20cm) +1 July which was significantly higher over rest of the treatments except treatment nine with (50cm x 20cm) +15 July, treatment five with (40cm x 20cm) +1 July, and treatment three with (50cm x 20cm) +15 June. The probable reason for the growth in plant elevation by use the treatment of (50x20 cm) +1 July were due to increase in the volume of air and decreases the competition between plants for soil moisture, nutrients, light and carbon dioxide due to spacing. Forage growth and production is high, these was reported by (Whister and Hymowitz, 1979) [36]. As well as the taller plant height was found in Guar plant due to optimum favorable temperature at sowing time and vegetative growth period. Adequate soil moisture and warm weather are essential for establishment of good crop stand. Planting in the last month of June was shown higher plant growth followed by higher yields. Thus, production of this crop in the Upper Midwest is unlikely (Undersander, D.J. *et al.*, 1991) [35].

#### Influence of date of sowing and spacing on branches per plant in cluster bean

Data in Table 1, tabulated the branches per plant of cluster bean and there was increasing in crop age plant elevation was improved with the advancement of experimentation. The branches per plant were significantly higher in all different growth intervals with treatment six with applications of (50cm x 20cm) +1 July (19.1) which was significantly higher over rest of the treatments except treatment nine with (50cm x 20cm) +15 July, treatment five with (40cm x 20cm) +1 July and treatment one with (30cm x 20cm) +15 June, which is statistically at par with the applications of (50cm x 20cm) +1 July. The probability increase the number of branch is no of branches were due to better availability of increases the volume of air and decrease the competition between soil moisture, nutrients, light and carbon dioxide due to spacing. Number of branches and forage growth is high these was reported by Malliswara and Sahadeva (2011) [24]. As well as the higher number of branch was found in Guar plant due to optimum favorable temperature at sowing time and vegetative growth period. Adequate soil moisture and warm weather are essential for establishment of good crop stand. Planting in the last month of June was shown higher number of branches and plant growth Reported by (Ali at al 2004) [3].

#### Influence of date of sowing and spacing on plant dry weight (g) in cluster bean:

Data in Table 2 tabulated the plant dry weight (g) of cluster bean and there was increasing in plant dry weight was improved with the advancement of experimentation. The plant dry weight was significantly higher in treatment six with (50cm x 20cm) +1 July (15.4 g) which was significantly higher over rest of the treatments except treatment nine with (50cm x 20cm) +15 July, treatment eight with (40cm x 20cm) +15 July, treatment five with (40cm x 20cm) +1 July, treatment four with (30cm x 20cm) +1 July, treatment three with (50cm x 20cm) +15 June, and treatment two with (40cm x 20cm)+15 June which were statistically at par with (50cm x 20cm) +1 July. The reason behind the plant dry weight study The probability increase the plant dry weight were due to increase in plant height number of branches and development of roots, spacing (availability of sun light, moister, nutrient and good air presser increase the nutrient resource, sun light, moisture) Taneja *et al* 1984) [30] and last june is the best date of sowind due to climatic condition according to gour growth likewise similar results reported by Kalyani *et al.* (2012) [19].

**Table 1:** Influence of date of sowing and spacing on growth characteristics in cluster bean.

	Treatment	Plant height (cm)	No. of Branches	Dry Weight (g)
		At Harvest	At Harvest	At Harvest
1	(30cm x 20cm)+15June	84.6	15.0	12.7
2	(40cm x 20cm)+15June	91.1	15.4	14.0
3	(50cm x 20cm) +15June	95.4	17.2	14.8
4	(30cm x 20cm)+1July	92.8	15.7	14.6
5	(40cm x 20cm)+1July	95.4	17.8	14.9
6	(50cm x 20cm)+1July	98.3	19.1	15.5
7	(30cm x 20cm) +15July	90.1	15.4	13.7
8	(40cm x 20cm) +15July	94.2	16.4	14.6
9	(50cm x 20cm) +15July	96.1	18.1	15.4
	F test	S	S	S
	S.Em(+)	1.00	0.44	0.50
	CD (5%)	3.00	1.33	1.49

### Influence of date of sowing and spacing on fresh yield (t/ha) and hay yield (t/ha) in cluster bean:

Data in Table 2 tabulated the fresh yield (t/ha) of cluster bean and there was increasing in fresh yield (t/ha) was improved with the advancement of experimentation. The At harvest, there was non-significant difference between the treatments and maximum the highest hay yield (t/ha) was observed in the treatment five with treatment (40cm x 20cm) +1 July (5.8 t/ha) where, treatment nine with (50cm x 20cm) +15 July shows lowest value of hay yield (4.7 t/ha) as compared to other treatments.

The reason behind the fresh yield and hay yield increase. The plant growth is low spacing (40x20cm) compare to spacing (50x20cm) due to availability of sun light, moisture, nutrient and good air pressure increase the nutrient resource, sun light, moisture. But plant population is high spacing (40x20cm) compare to spacing (50x20cm) and 1 July is the best date of sowing due to climatic condition according to gourd growth, so resulted (40cm x 20cm) +1 July is the best combination for higher forage yield, similar results reported by (Whistler and Hyinowitz, 1979) [36]

**Table 2:** Influence of date of sowing and spacing on growth characteristics in cluster bean.

	Treatment	Fresh Yield (t/ha)	Hay Yield (t/ha)
1	(30cm x 20cm)+15June	18.4	4.8
2	(40cm x 20cm)+15June	19.5	5.3
3	(50cm x 20cm) +15June	17.4	4.6
4	(30cm x 20cm)+1July	18.8	4.9
5	(40cm x 20cm)+1July	20.6	5.8
6	(50cm x 20cm)+1July	18.2	4.8
7	(30cm x 20cm) +15July	18.6	4.8
8	(40cm x 20cm) +15July	20.3	5.5
9	(50cm x 20cm) +15July	17.2	4.7
	F test	NS	NS
	S.Em(+)	0.92	0.55
	CD (5%)	-	-

### Influence of date of sowing and spacing on crude protein content and crude fiber content (%) in cluster bean

Data in Table 3 tabulated the crude protein content and crude fiber content (%) of cluster bean and there was increasing in crude protein content and crude fiber content (%) was improved with the advancement of experimentation. The At

harvest, there was non-significant difference between the treatments and maximum the highest crude fiber content (%) was observed in the treatment six with treatment (50cm x 20cm) +1 July (22.7%) where, treatment nine with (50cm x 20cm) +15 July, treatment one with (50cm x 20cm) +15 June shows lowest value of crude fiber content (21.7%) as compared to other treatments. The reason behind the improvement of Crude protein and Crude Fiber content might be due to the function of nutrient content that plays an important role in the protein synthesis. Similarly due to spacing (50x20 cm) with time of sowing (1 July), good availability of sun light, air and nutrient resources which may be enhanced the Crude protein and crude fiber content in the forage of guar. Likewise similar results reported by (Hansen and Krueger, 1973) and (Mohamed *et al.* 2008).

**Table 3:** Influence of date of sowing and spacing on yield and yield characteristics in cluster bean

	Treatment	Crude Protein(%)	Crude Fiber (%)
1	(30cm x 20cm) +15 June	16.1	21.1
2	(40cm x 20cm) +15 June	16.2	21.3
3	(50cm x 20cm) +15 June	16.8	21.8
4	(30cm x 20cm) +1 July	16.6	21.7
5	(40cm x 20cm) +1 July	16.9	22.0
6	(50cm x 20cm) +1 July	17.4	22.7
7	(30cm x 20cm) +15July	16.2	21.2
8	(40cm x 20cm) +15 July	16.6	21.7
9	(50cm x 20cm) +15 July	16.9	22.2
	F test	NS	S
	S.Em(+)	0.41	0.47
	CD (5%)	-	1.41

### Influence of date of sowing and spacing on economics of cluster bean

Data represented in table 4 shown the economics performance of different treatment combination which evaluation was based on cost of cultivation (₹/ha), gross return (₹/ha), net return (₹/ha) and benefit cost ratio (B:C). Highest cost of cultivation (27740 ₹/ha), Higher Gross return (72500 ₹/ha), Net returns (44760 ₹/ha) and Benefit cost ratio (1.6) were obtained by the with T5 (40cm x 20cm) +1 July Increase in economic performance of cluster bean were due to the positive effect of date of sowing and spacing combination on plants at higher marketable hay yield.

**Table 4:** Inflation of date of sowing and row spacing on economics of Cluster bean

	Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	(B:C) ratio
1	(30cm x 20cm) +15 June	26640	60000	33360	1.25
2	(40cm x 20cm) +15 June	25740	66250	40510	1.57
3	(50cm x 20cm) +15 June	25200	57500	32300	1.28
4	(30cm x 20cm) +1 July	26640	61250	34640	1.3
5	(40cm x 20cm) +1 July	27740	72500	44760	1.6
6	(50cm x 20cm) +1 July	25200	60000	34800	1.38
7	(30cm x 20cm) +15 July	26640	60000	33360	1.25
8	(40cm x 20cm) +15 July	25740	68750	43010	1.7
9	(50cm x 20cm) +15 July	25200	58750	33550	1.3

### Conclusion

On the basis of one season of experiment it may be concluded that with T5 (40cm x 20cm) +1 July at harvest recorded fresh yield (20.6 t/ha), hay yield (5.8 t/ha) and Crude protein content (17.4%), Crude fiber content (22.2%) as well as with greater (B: C ratio 1.7). yield (7.35 t/ha) were recorded in cluster bean.

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