EFFECTOFORGANIC,INORGANICANDBIOFERTILIZERSONGROWTH, YIELD AND QUALITY OF CLUSTER BEAN (*Cyamopsistetragonaloba*L.)

ABSTRACT

Clusterbean(*Cyamopsistetragonaloba*L.Taub)popularlyknownas"Guar"isan important legume crop mainly grown under rainfedconditions in arid and semi-regionsof Rajasthanduring*kharif*season.This study was conducted in the horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (UP) from July 2021- October 2021 to investigate the impact of organic, inorganic, and biofertilizers on the growth, yield, and quality of cluster beans (*Cyamopsistetragonaloba*L.*)*.TheexperimentwasconductedinthehorticultureResearchFarm,DepartmentofHorticulture,Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology andSciences, Prayagraj (UP) Duringfrom July 2021- October 2021. The experiment was laid out inRBDwithninetreatmentswiththreereplications.TheresultsrevealedthatT8(N20P50K50Vermicompost 5 t ha^{-1} + PSB 5 kg ha^{-1} + Rhizobium 5 kg ha^{-1}) – performed the best in termsof PlantHeight(140.22),NumberofBranches(21.39),LengthofPods(25.00),WidthofPods(3.70), Weight of Pods (4.10), Number of cluster per plant (21.60), Number of Pods per plant(89.17), Number of seeds per pod (11.80), Number of Pod yields per plant (196.87), Numberofpodyieldperplot(68.03),TSS(12)B:CRatio(2.5:1).

Therefore,thetreatmentT8(N20P50K50 Vermicompost 5 t ha^{-1} + PSB 5 kg ha^{-1} + Rhizobium 5 kg ha^{-1}) is the best whencompared to other treatments. As, the highest benefit cost ratio was observed in T8 (N20P50K50Vermicompost5tha^{-1}+PSB5kgha^{-1}+Rhizobium5 kgha^{-1}).i.e., (2.5:1) which states that iseconomicallyprofitablecompared to all other treatments.

Keywords:ClusterBean,Growth,yield,Quality.

INTRODUCTION

Clusterbean(*Cyamopsistetragonaloba*L.Taub)popularlyknownas"Guar"isan important legume crop mainly grown under rainfed condition in arid and semi-regionsof Rajasthanduring*kharif*season.Cluster bean (Cyamopsistetragonaloba L. Taub), often known as "guar," is a significant legume crop that is mostly farmed during the kharif season under wet conditions in desert and semi-arid parts of Rajasthan.Itisa veryhardyanddroughttolerantcrop.Itsdeep penetratingroots enable the plant to utilize available moisture more efficiently and thus offer better scopeforrainfedcropping.Thecropalsosurviveseveratmoderatein moderatesalinityand alkalinityconditions.Thereisnootherlegumecropsohardyanddrought aretolerantasClusterbean,whichisespeciallysuitedforthe soil and climate ofRajasthan. ***(*Kherawat*et al.*,2013*).*The pods of Cluster bean are as rich in food value as that of Cluster Bean.

Accordingto(**Aykroyd, 2007)**thecompositionofClusterbeanis81.0(g)moisture,10.8(9???)carbohydrate,3.2(g)protein,1.4(8)of fat,1.4(g)ofminerals,0.09(mg) thiamine,0.03(mg)riboflavin,47I.U.vitaminC,316I.U, vitaminA($100g^{-1}$)ofedibleportion.

Nitrogenisrequiredforthesynthesisofchlorophyllandaminoacids,whichcontribute to the protein building blocks and consequently plant growth.Clusterbean cultivars with nitrogen applied had higher crude protein, crude fibre, ash percentage,carbs,leafareaperplant,drymatter, andgreenfodderyields**(Ayub*et al.*,2010).**Phosphorus is the second most critical nutrient to add to the soil in order to maintainplant growth and crop yield **(Singh *et al.*, 2009).** It boosts rhizobium activity and promotes the pro-duction of root nodules. As a result, it aids in the fixation of more nitrogen from the atmospherein root nodules, **Handbook ofAgriculturebyICAR, (2010).** Potassiumbenefits ascribed to k includethe resistance of plant against pest, disease, and stresses caused by drought, salinity, and sodicity in assuring improving crop quality characteristics**(Kherawat*etal.*, 2013).**Farmyardmanuretheorganicmanurelike FYMistheoldestandcheapestsource of nutrientsbeingpopularfromtheancientin ancienttimes.ApplicationofFYMonfieldto enrichthesoil fertility is an old practice unlike chemical fertilizers which contain only one, two orthree plantnutrients.FYMseemstoactdirectly for increasing thecropyieldseither bythe accelerationofrespiratoryprocesswithincreasingcellpermeabilityandhormonalgrowth action or by a combination of all these processes. FYM provides plants with both macroand micronutrients. A well decomposed FYM contains 0.5%N,0.2%P2O5and0.5%K20, **Handbook ofAgriculture by ICAR,(2010).Vermicompost** are products derived from the accelerated biological degradation oforganic wastes by earthworms and microorganisms. Earthworms consume and fragment theorganic wastes into finer particles by passing them through a grinding gizzard and derive theirnourishment from microorganisms that grow upon them. These materials contained mineral contents (% dry weight) ranging from 2.2–3.0 N,0.4-2.9P,1.7-2.5K,and1.2-9.5Cacomparedtothoseofacommercialplantgrowth**(Arancon*etal.*, 2005).*Rhizobium***the use of biofertilizersis moreeco-friendly in nature. They can play asignificant role in fixing atmospheric nitrogen; biofertilizerenriches soil fertility and improvessoilfertility.Ofthese biofertilizers,*rhizobium*inoculantsspecificfordifferentleguminouscropsin the most important in India. The largest contribution of biological nitrogen fixation toagricultureisderived from thesymbiosisbetweenlegumesand*Rhizobium*species.So, this study was conducted to investigate the impact of organic, inorganic, and biofertilizers on the growth, yield, and quality of cluster beans (*Cyamopsistetragonaloba*L.*)*.

MATERIALS AND METHODS

The experiment was conducted at Experimental Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) in2021 during Kharif season in India. The experiment material consists of MDU 1 variety of cluster beans, which is released from Tamil Nadu agricultural university, Tamil Nadu. The soil of the experimental field was alkaline, with sandy loam and a pH of 7.2.

The pit was dugwith 30×30×30 cm^3 and the applied dose of FYM is 20 tonnes/ha and N, P, and K is 20 kg, 50kg and 50kg/ha, respectively. The experiment was laid out in randomized block design with three replications consisting of eight treatment combinations, inorganic fertilizers, two kinds of organic manures (FYM and vermicompost) and biofertilizers(Rhizobium abd PSB) alone, some treatments are comprised of organic manures with biofertilizers and different quantity levels of inorganic fertilizers.The plot size was 45cm×30cm spacing rows and plants. Statistical analysis of variance was performed on the data collected throughout the experiment. The observation was recorded for Plantheight(cm), NumberofBranchesperplant, Lengthofpods, Width of pods, Weight ofpods, NumberofClusterperplant, NumberofPods perplant, NumberofSeedsperpod, Numberofpodyieldperplant(g), Numberofpodyieldperplot(kg), TotalsolublesolidTSS(˚Brix), economics wereanalyzed statistically. The significance of the treatments was determined using the 'F' test at a level of significance of 5%.

3. RESULTS AND DISCUSSION

Growth Parameters

The data on growth parameters in different treatment combinations were recorded (Table 1).Themaximumheight(33.50,48.83and140.22cm)at30,60,90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+Rhizobium. While the minimum Plant height was recorded in Absolute Control (23.83, 38.00and94.30 cm). It might be due to improved soil's physical, chemical and biological properties. Higher availability of all plant nutrients resulted in the improved plant characters like plant height. These findingsare in conformity with the findings of, **Kumar *et al.* (2004) and Ashwini (2005)** in French bean**.**

The maximum Number of Branches (15.50, 17.67 and21.39)at30,60,90DATwasrecordedon80%RDFChemicalfertilizers+20%Vermicompost + PSB+ Rhizobium. While the minimum Number of Branches was recorded inAbsoluteControl (6.18, 8.17 and 8.94). An increasein the number of branches per plant due to PSB inoculation may be attributed to the conversion of unavailable phosphorus to available forms particularly during the early crop growth phase which would have helped in the absorption of all major and minor nutrients required for the plant to put forth early vigour in vegetative phase and helps to increase the numberof branches similar observations were also recorded by **Prasad *et al*., (2013)** in cowpea.

Yield Parameters

MaximumLengthofPods(25.00)at90DATwasrecordedon 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ Rhizobium. While theminimumLength of Pods was recordedinAbsoluteControl (8.83). Increase in LengthAn increase in the Lengthof pods is due to better assimilation ofphotosynthatesandbetterportioningintodevelopingpodclusters that havetakenplaceandimproving yield attributing characters like pod length and diameter. Similar results are in accordance with the**Ashwini (2005)**in FrenchBean**.**Width of Pods (3.70) at 90 DAT

was recordedon80%RDFChemicalfertilizers+20%Vermicompost+PSB+Rhizobium.Whilethe minimumWidthof Podswas recorded in AbsoluteControl(2.50). At various amounts of NPK, Vermicompost, PSB, and Rhizobium, the mean value of the Width of Pods was determined to be significant. Enhanced yield attributing features such pod width have occurred due to improved photosynthate assimilation and better portioning into growing pod clusters. **Nirmala and Vadivel (1978)** made similar observations in cucumber. WeightofPods(4.10)at90 DAT wasrecordedon 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+ Rhizobium. While theminimumWeight of Pods was recordedin Absolute Control(2.50). At various amounts of NPK, Vermicompost, PSB, and Rhizobium, the mean value of the Weight of Pods was determined to be significant. Enhanced yield attributing features such pod width have occurred due to improved photosynthate assimilation and better portioning into growing pod clusters. **Gandhi and Sivakumar (2010)** made similar observations about cucumbers.

NumberofClusterperplant(21.60)at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+Rhizobium.WhiletheminimumNumberofClusterperplantwas recordedinAbsoluteControl(14.42). PSB could be the greater availability of nutrients in the soil and resulted in better growth and development which might be attributed to the better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance in the plant system **Ramana*et al.*,(2011).**The number of Pods per plant (89.17) at90DATwasrecordedon80%RDFChemicalfertilizers+20%Vermicompost+PSB+Rhizobium. While the minimum Number of Pods per plant was recorded in Absolute Control(67.40).

The maximum Number of Seeds per pod (11.80)at 90 DAT was recorded on 80% RDF Chemical fertilizers + 20% Vermicompost + PSB+Rhizobium. While the minimum Number of Seeds per pod was recordedin Absolute Control(7.93).The significant improvement in yield attributes of cluster bean was due to the fact that rhizobium inoculation increased the root volume through better root development, nodulation, and more nutrient availability resulting in vigorous plant growth which in turn results in better flowering, pod formation and increased pod yield. Since, PSB helps in reducing phosphorus fixation by its chelating effect and also solubilized the fixed phosphorus leading to more uptakes of nutrients and reflected in better yields. Similar findings were found by **Mishra and Baboo (2002)**.

ThemaximumNumberofPodyieldsper plant(196.87)at90DATwasrecordedon80%RDFChemicalfertilizers+20%Vermicompost+ PSB+ Rhizobium. While the minimum Number of Pod yields per plant was recordedinAbsoluteControl (156.47).PSB could be due to the greater availability of nutrients in the soil and resulted in better growth and development which might be attributed to the better mobilization of phosphorus and increased allocation of photosynthates towards the economic parts and also hormonal balance in the plant system. These findings are in conformity with the findings of, **Ramana*et al.*, (2011).**The higher mobilization of phosphorus and increased allocation of photosynthates to the economic portions as well as hormonal balance in the plant system may be responsible for PSB's

increased nutrient availability in the soil and the better growth and development that occurred. These results are consistent with those of **Ramana*et al.*, (2011).**The maximum Number of Pod yields perplot(68.03)at90DATwasrecordedon80%RDFChemicalfertilizers+20%Vermicompost + PSB+ Rhizobium. While the minimum Number of Pod yields per plotwas recordedin Absolute Control (46.47). The Enhancing yield attributing features such pod width have occurred due to improved photosynthate assimilation and better portioning into growing pod clusters. **Gandhi and Sivakumar (2010)** made similar observations about cucumbers.

The maximum TSS (Brix) (12) at 90 DAT was recorded on 80%RDF Chemical fertilizers + 20% Vermicompost + PSB+ Rhizobium. While the minimumTSS (Brix) was recorded in Absolute Control(8.66). The increased protein content is attributed to an increasein N content and uptake by the crop due to phosphorus application. The increaseof protein content of cluster beansover due to the seed inoculation increased the N content of pods which ultimately reflects the TSS content of pods. Similar findings were found by **Tripathi and Edward (2017) in guar.**

Table 1 : Plant characteristics

Plant Height			Number of Branches			Length of pods	Width of pods	Weight of pods	No. of cluster plant^{-1}	No. of pods plant^{-1}	No. of seeds pod^{-1}	Pod yield plant^{-1}	Pod yield plot^{-1} (kg)	TSS
30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS									
23.83	38	94.3	6.18	8.17	8.94	8.83	2.5	2.5	14.42	67.4	7.93	156.5	46.47	8.66
25.67	41.28	100.7	7.5	10.39	17.99	12.5	2.55	2.55	15.37	71.43	8	169.9	47.27	9.33
27.56	44.33	103.9	8.5	12.39	18.05	12.51	2.59	2.59	16.02	73.22	8.06	176.5	48.43	10.4
26.5	38.07	122.8	7.5	15.06	21	16.75	2.89	3.1	19.39	82.71	9.33	184.6	57.32	10.83
27.5	37.6	122.3	12	15.1	20.13	16	2.8	2.9	18.66	79.13	9.26	180.5	56.64	10.8
28.06	40.63	110.8	7.78	12.22	18.67	14.1	2.6	2.6	16.89	78.42	8.4	178.1	49.47	10.5
26.89	38.39	122.2	6.6	14.94	19.67	15	2.7	2.8	17.15	78.46	8.46	179.1	50.55	10.6
30.83	45.17	130.3	12	15.1	21.39	21	2.9	3.5	19.82	85.34	11.46	192.1	67.33	11
33.5	48.83	140.2	15.5	17.67	21.39	25	3.7	4.1	21.6	89.17	11.8	196.9	68.03	12
S	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
0.71	**2.31**	**8.45**	**0.53**	**0.78**	**1.09**	**1.00**	**0.18**	**0.19**	**1.12**	**4.63**	**0.442**	**8.93**	**0.36**	**0.65**
2.01	**4.40**	**5.03**	**4.58**	**4.76**	**4.60**	**4.96**	**4.91**	**5.07**	**4.91**	**4.78**	**3.79**	**3.92**	**4.51**	**4.91**
0.342	**1.111**	**4.076**	**0.25**	**0.376**	**0.523**	**0.484**	**0.084**	**0.09**	**0.52**	**2.23**	**0.213**	**4.3**	**0.17**	**0.31**

CONCLUSION

The result from the present investigation concluded that the treatment T_8 which received RDFChemical fertilizers + 20% Vermicompost + PSB + Rhizobium was found superior in Plantheight,Number of branches, Number of days of first picking, Average fruit width, Fruit yield per plant(kg), Number of seeds per fruit, Average fruit length, Number of clusters plant, Number of podsinacluster, TSS˚(Brix),net income of84750.00Rs./haandB:C ratio of 2.5.

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