International Journal of Environment and Climate Change

Volume 13, Issue 11, Page 1123-1135, 2023; Article no.IJECC.107481
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Influence of Pre-sowing Seed Treatments with Botanical and Organics on Yield Attributing Traits and Seedling Parameters of Cluster Bean (*Cyamopsis tetragonoloba* L) Variety: RGC1066

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i113262

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/107481

Original Research Article

Received: 03/08/2023
Accepted: 09/10/2023
Published: 18/10/2023

ABSTRACT

The current global scenario firmly emphasizes the need to enhance eco-friendly agriculture practices for sustainable agriculture. Chemical agriculture has made an adverse impact of the health care of not only soil but also the beneficial soil microbial communities and the plants cultivated in these soil. This eventually has led to a high demand of botanical and organic produce

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by the present day health conscious society and periodic attempts are being made by farmers all over the world to depollute. Application of heavy doses of chemical fertilizers and pesticides are being used by the farmers to get a better yield of various agricultural crops. These chemical fertilizers and pesticides decrease soil fertility and cause health problems to the consumers. The new approaches to the use of botanical and organic amendments in farming have proven to be effective means of improving soil structure, enhancing soil fertility and increasing crop yields. Botanical and organics play vital roles in increasing soil fertility and increasing yield. The study was designed to check the response of botanical and organics on yield and seedling quality parameters such as field emergence percent, plant height (30, 60, 90 DAS), days to 50% flowering, number branches per plant, number of pods per plant, number of clusters per plant, days to maturity, seed yield per plant, seed yield per plot, harvest index, germination percentage, speed of germination, root length, shoot length, seedling length, seedling dry weight, seedling fresh weight, seedling growth rate, root: shoot ratio, seed metabolic efficiency, mobilization efficiency, vigour index-I, vigour index-II, electrical conductivity. For this experiment the seeds of RGC1066 variety collected from department of genetics and plant breeding, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj during 2021-2022, to find out the influence of pre-sowing seed treatments with botanical and organics, seeds treated with panchagavya, beejamruth, jeevamruth, neem leaf extract and vermiwash at different concentrations viz 2, 3, 5, and 10% for 12hours along with control (no treatment). It is found that all treatments showed improved performance than untreated seeds, but it was observed that seeds treated with panchagavya@10% for 12 hours performed better in comparison to other treatments. This study can be helpful to reach new horizons of research in the field of sustainable agriculture, natural resource conservation and seed technology to overcome the germination problem and improve crop growth and yield eventually.

Keywords: Cluster bean; panchagavya; beejamruth; jeevamruth; neem leaf extract; vermiwash; sustainable agriculture.

1. INTRODUCTION

Botanical and organic farming has been drawing the attention of the world for the past few years. It is an environmentally friendly, sustainable way of farming with zero use of chemicals. Adoption to eco friendly and sustainable farming practices like use of botanical and organic treatments can not only reverse the declining trend in the global productivity but also will help in environment protection (Naikwade et al*.,* 2012). Botanical and organic seed treatments reduce the use of chemicals and protects plants from seed borne diseases and pest [1-4]. Organic seed treatments like panchagavya, beejamruth, jeevamruth, vermiwash and botanical seed treatments viz, neem leaf extract showed better results in yield and seedling parameters in cluster beans, which are made from locally available ingredients in the farm [5-9]. These are rich in sources of beneficial microorganisms and nutrients which help in the plant growth, help in getting good quality yield, increase in the germination percent in the laboratory [10-13].

Cluster bean (*Cyamopsis tetragonoloba* (L). crop with a chromosome number of 2n=2x=14 which is popularly known as guar, chavlikayai, guari, and khutti. It is a self-pollinated crop belonging to the family Fabaceae (Kalyani, 2006). The cluster bean is an annual, erect, herbaceous and robust legume. It has indeterminate growth habit and can grow up to 0.4 to 4.0 m. with a life cycle of 80 to 160 days; it has a deep taproot system with well-developed lateral roots. Roots are covered with light colored root nodules. Flowers borne in clusters giving the common name cluster bean, flowers pass through an array of from white to deep blue from the bud stage to petal drop, pods are linear, erect, clustered, beaked, compressed with double ridges on the dorsal side and single ridge on the front side. Pods are larger, fleshy and glabrous [14-17]. A pod varies single and double seeded to twelve seeds and seeds are light gray, purpled coloured. The importance of guar has increased considerably in recent years due to the general ecological trend of utilizing polysaccharides of renewable plant origin in different industrial applications [18-21]. Recently, galactomannans have also been used in the production of water proof biocide films (Das et al., 2011). On the other hand guar is considered as an excellent soil improvement crop, like other legumes, with respect to available nitrogen which improves yield of improvement crops, like other legumes, with respect to available nitrogen which improves yield of succeeding crops. It is used as an adsorbent in wastewater treatment and in the

textile industry as an flocculating and exchanging agent. In waste water purification, guar gum is used as a gelatinizing agent (Mathur et al., 2006). The nutritional value per 100 gm of raw cluster bean is one of the most important and potential vegetable cum industrial crops grown for its tender pods for vegetable purpose and for endospermic gum (30-35%) (Kumar and singh, 2002).

2. MATERIALS AND METHODS

RGC1066 cluster bean seeds (*Cyamopsis tetragonoloba* L.) variety was collected from the department of genetics and plant breeding, Sam Higginbottom University of Agriculture Science and Technology, prayagraj were used to study under field conditions during Kharif, 2021-22. The climatic conditions recorded from the university meteorological station. The mean values of temperature, relative humidity, rainfall and wind speed were 33.85^{o}C, 83%, 20.22mm, 14km/h respectively. Botanical and organic treatments were prepared as follows. Panchagavya was prepared from cow products viz, cow milk($2^{1/2lit}$), ghee(1/2lit), cow urine($2^{1/2lit}$), curd(1kg), cow dung($2^{1/2kg}$) from locally available ingredients were mixed thoroughly along with (5kg) jaggery this mixture was added with 5lit of water and kept for fermentation for 30days. After fermentation the fermented liquid was filtered through cotton and the final volume of filtrate was made 1000 ml. The solution was stored in the refrigerator. 7 % of the solution was used for treatments.

Beej Amrutham (Protocol given by Palekar, 2006) was prepared by using local cow dung(5kg) was taken in a cloth and bound by tape and was submerged in 20 liters of water in a separate container and kept stable overnight. After 12 hours, this bundle of cow dung was squeezed thrice, 1 kg of soil was dissolved in cow dung extract by stirring it well. To this 5 liters of desi cow urine and lime water was added and mixed well. The seeds were immersed in beejamrutham solutions of different concentrations (2%, 5% and 10%) for 12 hours then dried in a shed and later used for study.

Jeevamrutham was prepared by taking 125 g fresh cow dung, 375 ml cow urine(old), 50 g black jaggery, 50 g pulse flour and 2.5 g live soil mixed with 5 l of water. Solution was kept for 2-7 days in shade for fermentation. During fermentation, the solution was stirred daily. The lid of the container should be kept loose (Palekar, 2006). After fermentation The seeds were immersed in jeevamrutham solutions of different concentrations (2%, and 5%) for 12 hours then dried in a shed and later used for yield and seedling quality parameters.

Neem leaf extract was prepared by collecting fresh leaves of neem plant, washed, dried under shade. The shade dried leaves were powdered using pestle and mortar. Then 30 grams of leaf powder was taken using weighing balance and dissolved in 100ml of distilled water which was measured already in the beaker to make 3% leaf extract. The leaf extract was filtered by using muslin cloth to get rid of unwanted material and leaf debris. Seeds were soaked in the leaf extract at room temperature for 4 hrs. The seeds were dried under shade and used for germination.

Vermiwash may be collected from the vermicompost units as a by-product of liquid extract. The coelomic fluid of earthworm is called vermiwash.

After preparation of Seeds soaking in the solution: solutions of Panchagavya, Beejamrutham, Jeevamrutham, Neem leaf extract, Vermiwash the selected crop variety (RGC1066) cluster bean seeds were soaked in required solution for 12 hrs at 25^{0}C temperature. Untreated seed is called as control. After 12 hours of soaking, the solution is drained out from the beakers and pre-soaked, air dried to original weight and then seeds are sown in the field for occurring field observations. After successful yield, the harvested seeds after a period of storage were used for germination in a laboratory under controlled conditions in the Department of Genetics and plant breeding.

The field parameters were collected from the Randomized block design with three replications. Observations on field viz, field emergence, plant height (30, 60, 90days), days to 50% flowering, number of branches per plant, number of pods per plant, number of clusters per plant, days to maturity, seed yield per plant, seed yield per plot, harvest index the data was collected and statistically analyzed using anova. The seedling quality parameters were collected from the complete randomized design with four replications. Observations on laboratory conditions are germination percent, speed of germination, root length, shoot length, seedling length, seedling growth rate, fresh weight of seedling, dry weight of seedling, root: shoot ratio, seed metabolic efficiency, Mobilization efficiency,

vigour indices, electrical conductivity the data was collected and statistically analyzed using anova.

3. RESULTS AND DISCUSSION

According to the findings, all the characteristics analyzed were influenced by the treatment and the difference between control (untreated seeds) and treated seeds in Table 2 & was entirely relevant. Researchers are recommending several pre sowing seed management techniques with the benefit of protection of soil fertility, production and high yield of crops and resistance to pest and diseases through seed borne. In the field experiment revealed that the panchagavya @10% for 12 hours recorded higher values for the yield and seed quality trails *viz.,* field emergence(94.44%), plant height 30, 60,90 DAS (21.74 cm, 40.81 cm, 60.53 cm) Kumaravelu et al*., (*2009) it also shows best performance in days to 50% flowering(42days)Beaulah(2001), number of branches per plant(7.37), number of pods per plant(93.06), number of clusters per plant(8.33)Natarajan (2002), highest seed yield per plant(26.53g) and seed yield per plot with(852.05g) same results was observed by somasundaram (2003).panchagavya @10% also showed beat results in seed quality parameters like highest germination percent by (91%), speed of germination (25.52), highest root and shoot length was observed by T3 (11.50cm, 15.41cm)similar results were observed by Jayanth kumar et al*.*, (2017). Panchagavya also showed best results in seedling fresh weight and dry weight (5.58g, 0.473g) reported by Bagul et al*.,* (2018). Jayanth (2017) reported that panchagavya used to bring highest results in seedling growth rate, seed metabolic efficiency and vigour indices because of panchagavya contains beneficial microbes which naturally increases growth and yield of crops. Highest seed metabolic efficiency was recorded by the T3-panchagavya @10% compared to other seed treatments and crontro(untreated seeds) (0.627%),mobilization efficiency with(235.0%), and also shows best results in the vigour index-I and vigour index-II with(1959.3 & 31.26).

3.1 Growth Attributes

The field emergence was found to be significant and maximum was observed in T3-panchagavya@10% (94.4%) whereas minimum was observed in T0- Control (66.7%). The plant height@ (30, 60, at harvest) was found to significant and maximum was observed in T3-panchagavya@10% (21.74 cm, 40.81 cm, 60.53 cm) whereas minimum was observed by T0-Control (15.55 cm, 32.45 cm, 50.74 cm). The maximum number of branches per plant was observed by T3-Panchagavya @ 10% (7.37) whereas the minimum number of branches per plant by T0- Control (3.8). similar results were also reported by Balakrishnamurthy et al,. (2006), Anjuna, S and Vijayalakshmi, C.N (2014), Vennila et al,. (2008), Sunil et al.,(2012), carol Lyngdon et al., (2017), Patel et al., (2013), Swaminathan et al., (2007), Gopal et al., [22].

3.2 Reproductive Attributes

Among thirteen treatments the days to 50% flowering found to be significant and the lowest days was reported in T3-panchagavya@10% (42.00) and it was followed by T_2–panchagavya @5% (42.66) and T_3-panchagavya @10 % (44.66).highest days to 50% flowering was found in untreated seeds (56.33). Days to maturity was found to be significant and least days was reported in T3-Panchagavya @ 10% (90) and maximum days to maturity was observed in T_0 – Control (107.3).

3.3 Yield Attributes

The Number of pods per plant was found to significant and maximum was observed in T3-panchagavya@10% (81.26) whereas minimum was observed in T0- Control (55.26). The Number of clusters per plant was found to significant and maximum was observed in T3-panchagavya@10% (8.33) whereas minimum was observed in T0- Control (4.93). The seed yield per plant was found to significant and maximum was observed in T3-panchagavya@10% (26.53g) whereas minimum was observed in T0- Control (13.32g). The Seed yield per plot was found to significant and maximum was observed in T3-panchagavya@10% (852.05g) whereas minimum was observed in T0- Control (333.31g). The Biological yield was found to significant and maximum was observed in T3-panchagavya@10% (347.62g) whereas minimum was observed in T0- Control (140.77g). The Harvest index was found to significant and maximum was observed in T3-panchagavya@10% (146.93%) whereas minimum was observed in T0- Control (78.66%). Balakrishnamurthy et al,. (2006), Anjuna, S and Vijayalakshmi, C.N (2014), Vennila et al,. (2008), Sunil et al., (2012), carol Lyngdon et al., (2017),

Patel et al., (2013), Swaminathan et al., (2007), Gopal et al., [22].

3.4 Correlation Coefficient

As stated in Table 5 correlation coefficient revealed that seed yield per plot showed positive significant association with number of seeds per plant, harvest index, biological yield, number of clusters per plant, number of pods per plant, days to maturity, plant height at harvest, 50% flowering at both phenotypic and genotypic levels, indicating an increase in seed yield with an increase in these characters. Similar findings were reported by S.Bisht et al.,(2018) vigour index-I showed positive significant association with number of seed metabolic efficiency, mobilization efficiency, seedling dry weight, seedling fresh weight, seedling growth rate, vigour index-II, root length, shoot length, seedling length at both phenotypic and genotypic levels, indicating an increase in seed yield with an increase in these characters.

3.6 Path Analysis

Path analysis revealed that positive direct effect with the seed yield per plant, harvest index, biological yield, days to maturity, plant height at harvest on seed yield per plot on both phenotypic and genotypic level.

Table 1. Treatment details

S. No.	Treatment	Botanical and organics	Percentage	Duration
1	T_0	Control	-	-
2	T_1	Panchagavya	3%	12 hours
3	T_2	Panchagavya	5%	12 hours
4	T_3	Panchagavya	10%	12 hours
5	T_4	Beejamrutham	2%	12 hours
6	T_5	Beejamrutham	5%	12 hours
7	T_6	Jeevamrutham	5%	12 hours
8	T_7	Jeevamrutham	10%	12 hours
9	T_8	Neem leaf extract	3%	12 hours
10	T_9	Neem leaf extract	5%	12 hours
11	T_{10}	Neem leaf extract	10%	12 hours
12	T_{11}	Vermiwash	3%	12 hours
13	T_{12}	Vermiwash	5%	12 hours

Table 2. Analysis of variance for field parameters evaluated in cluster bean

S. No.	Characters	Mean sum of squares		
		Replications (df=2)	Treatments (df=12)	Error (df=24)
1	Field Emergence %	8.20	0.09**	0.02
2	Plant Height@ 30 DAS	1.62	7.48**	1.46
3	Plant Height@ 60 DAS	68.98	27.59**	8.23
4	Plant Height@ 90 DAS	79.38	35.06**	11.08
5	Number of Branches per plant	0.05	2.63**	0.86
6	Days to 50% Flowering	40.92	45.27**	14.67
7	Number of pods per plant	41.97	271.40**	23.12
8	Number of clusters per plant	2.63	2.41**	0.34
9	Seed Yield per Plant	5.88	43.96**	7.99
10	Seed Yield per Plot	3690.17	6665.16**	1858.48
13	Harvest index	1100.06	1792.04**	555.82

Table 3. Analysis of variance for laboratory parameters evaluated in cluster bean

S. No.	Characters	Mean sum of squares	
		Treatments (df=12)	Error (df=26)
1	Germination percentage (%)	608.80*	58.28
2	Speed of germination(days-1)	47.33*	6.16
3	Root length(cm)	6.24*	0.09
4	Shoot length(cm)	13.04*	0.056
5	Seedling length(cm)	35.53*	0.083
6	Seedling fresh weight(g)	4.34*	0.32
7	Seedling dry weight(g)	0.036*	0.005
8	Root: Shoot ratio	0.020*	0.005
9	Seedling growth rate	0.707	0.036
10	Seed metabolic efficiency (%)	0.073*	0.015
11	Mobilization efficiency (%)	8977.0*	1789.07
12	Vigour index – I	73362.8*	34853.8
13	Vigour index – II	301.12*	25.60
14	Electrical conductivity(dsm-1)	0.101*	0.013

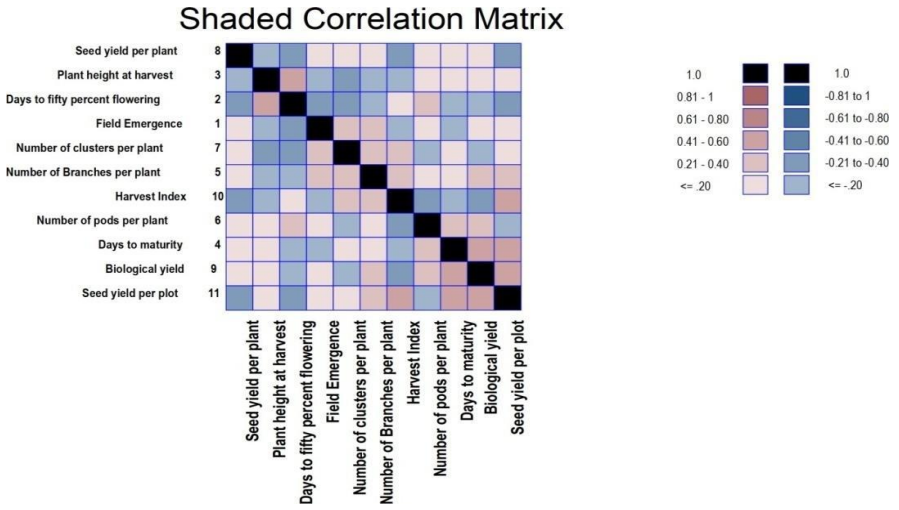

Fig. 1. Phenotypic shaded correlation matrix for yield per plot

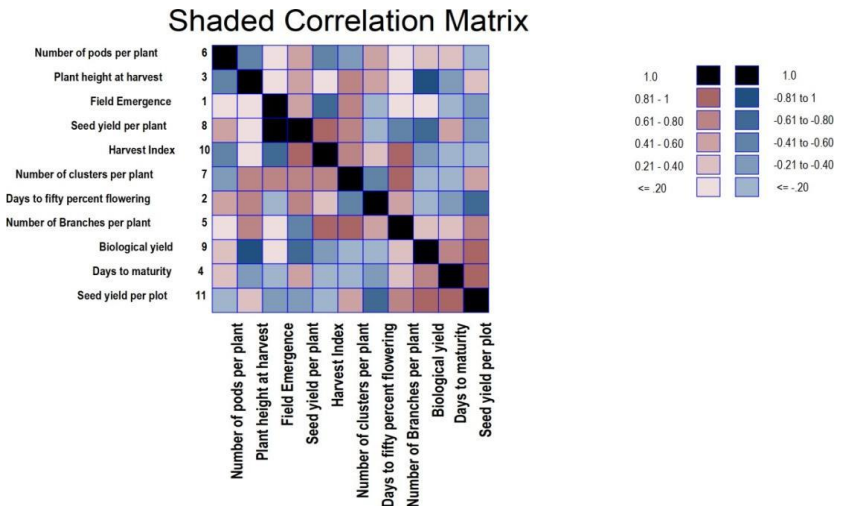

Fig. 2. Genotypic shaded correlation matrix for yield per plot

Table 4. Mean performance of cluster bean for field characteristics

1	Treatments	Field Emergence %	Plant Height 30 Das (cm)	Plant Height 60 Das (cm)	Plant Height At harvest (cm)	Days to 50% flowering (days)	No of branches per plant	Days to maturity	Number of pods Per Plant	Number Of Clusters per plant	Seed Yield Per plant	Seed Yield Per Plot	Harvest Index
1.	T_0	**69.44**	**15.55**	**32.45**	**50.74**	**56.33**	**3.80**	**107.3**	**55.26**	**4.93**	**13.32**	**333.31**	**78.66**
2.	T_1	80.55	16.11	35.21	58.98	46.33	5.60	92	70.60	6.40	19.78	469.72	103.94
3.	T_2	66.66	16.62	34.06	55.76	42.66	5.86	95	78.46	7.06	23.91	669.92	143.61
4.	T_3	**94.44**	**21.74**	**40.81**	**60.53**	**42**	**7.37**	**102**	**93.06**	**8.33**	**26.53**	**852.05**	**128.67**
5.	T_4	80.55	15.68	34.08	56.04	44.66	6.20	90	70.26	6.06	18.32	547.91	105.10
6.	T_5	74.99	16.09	35.37	58.40	45	6.40	100	81.26	7.33	24.63	680.46	125.47
7.	T_6	83.33	17.07	35.13	58.69	47.33	5.73	96	81.20	7.06	17.67	570.23	96.92
8.	T_7	88.89	16.82	40.66	59.51	45.33	5.00	97.3	72.53	6.06	20.11	610.43	116.27
9.	T_8	83.33	17.16	32.82	60.03	48.33	6.27	99	75.46	6.83	26.52	640.18	146.93
10	T_9	91.66	17.29	32.72	59.09	46.66	5.27	95	78.00	7.06	22.23	448.55	81.59
11	T_{10}	91.66	17.71	40.72	59.14	51	5.87	94	70.08	6.04	18.13	480.22	75.14
12	T_{11}	75.00	17.32	35.42	50.97	51	6.20	105.6	60.04	5.04	22.37	763.95	94.72
13	T_{12}	75.00	16.52	34.95	52.97	49.33	7.33	96	76.04	7.00	21.78	489.7	82.13
Grand Total		1055.5	221.96	464.38	740.88	616.00	76.90	1268.6	963.70	87.03	275.52	7557.98	1379.16
F Test		**S**	S	S	S	S	S	S	S	S	S	S	S
SE(m)		0.09	0.70	1.66	1.92	2.21	0.53	2.07	2.78	0.33	1.63	24.89	32.85
SE(d)		0.13	0.98	2.34	2.72	3.13	0.76	2.92	3.98	0.47	2.31	35.20	46.46
C.D		4.44	7.07	8.03	5.84	8.08	15.06	3.67	6.49	8.66	13.34	22.25	22.22

Table 5. Mean performance of cluster bean for lab observations

1	Treatments	Germination percent (%)	Speed of germination ($days^{-1}$)	Root Length (cm)	Shoot Length (cm)	Seedling Length (cm)	Fresh Weight (g)	Seedling Dry Weight (g)	Root: shoot Ratio	Seedling growth rate	Seed Metabolic efficiency (%)	Mobilization efficiency (%)	Vigour index I	Vigour Index II	Electrical Conductivity (dsm^{-1})
1.	T_0	**40.5**	**11.48**	**6.44**	**8.44**	**14.90**	**1.45**	**0.144**	**0.61**	**1.73**	**0.201**	**68.75**	**482.48**	**4.464**	**1.311**
2.	T_1	82	21.94	9.90	13.14	23.06	3.51	0.290	0.86	2.70	0.342	143.75	1420.3	18.68	1.287
3.	T_2	77	23.56	10.39	14.43	24.82	2.51	0.320	0.78	2.82	0.506	158.75	1529.2	19.592	1.288
4.	T_3	**91**	**25.52**	**11.50**	**15.41**	**26.92**	**5.58**	**0.435**	**0.89**	**3.71**	**0.627**	**215.0**	**1959.3**	**31.26**	**1.542**
5.	T_4	67.5	21.59	10.40	13.49	23.90	3.35	0.473	0.79	2.69	0.421	235.0	1290	25.46	1.644
6.	T_5	70	22.29	9.67	14.46	24.17	2.51	0.375	0.84	2.77	0.438	185.0	1353.2	18.84	1.800
7.	T_6	68.5	20.85	9.57	14.44	24.02	3.64	0.356	0.77	2.92	0.576	175.0	1314.1	19.21	1.562
8.	T_7	57.5	18.13	10.80	14.23	25.04	4.60	0.440	0.73	2.90	0.478	217.5	1143	19.15	1.391
9.	T_8	66	18.94	10.32	13.46	23.79	3.96	0.406	0.75	2.96	0.481	201.2	1255.3	17.65	1.449
10	T_9	66.5	18.83	9.45	14.48	23.94	2.88	0.422	0.83	2.87	0.447	208.7	1273.4	22.11	1.548
11	T_{10}	76.5	20.83	10.30	14.22	24.65	3.77	0.421	0.84	2.68	0.312	208.7	1508	23.13	1.660
12	T_{11}	67	19.92	9.56	12.39	21.95	4.30	0.271	0.82	3.06	0.253	133.7	1176.1	11.9	1.461
13	T_{12}	59.5	17.25	8.39	11.50	19.85	3.55	0.252	0.80	2.92	0.597	123.7	905.0	9.08	1.360
Grand mean		68.42	20.08	9.74	13.39	23.15	3.50	0.354	0.79	2.825	0.436	218.3	1277.6	18.50	1.484
C.V.		11.15	12.35	3.086	1.76	1.244	16.34	19.6	8.54	6.66	41.05	19.77	11.69	21.8	7.66
SE(m)		3.817	0.24	0.150	0.118	0.144	0.287	0.035	0.034	0.094	0.061	17.30	93.3	93.3	2.530
SE(d)		5.398	1.75	0.213	0.168	0.204	0.406	0.049	0.048	0.133	0.086	24.47	132.01	132.01	3.578
C.D		10.960	3.56	0.432	0.340	0.413	0.823	0.100	0.098	0.271	0.175	49.6	268.02	268.02	7.264

Table 6. Phenotypic and genotypic correlation matrix

	FE	50 % F	PH(cm)	DM	NBPP	NPPP	NCPP	SYPP	BY	HI	YP
rp	**1**	-0.2258	-0.0198	-0.0651	0.2303	0.0931	0.2525	0.123	0.0979	-0.0259	0.1906
FE rg	1	-0.1355	0.0416	-0.0035	0.0923	0.0619	0.633**	0.547**	0.1102	-0.649**	-0.2694
rp		1	0.498*	-0.0782	-0.0053	0.2773	-0.2	-0.2731	-0.0453	0.0568	-0.2697
50%F rg		1	-0.723**	-0.3019	0.509**	0.540**	-0.480*	-0.541**	-0.0309	0.2109	-0.610**
Rp			1	0.0146	-0.0467	0.1486	-0.2116	-0.0243	0.1913	-0.0742	0.0503
PH rg			1	-0.388*	-0.821**	-0.473*	0.630**	0.824**	-0.885**	0.0088	0.2277
rp				1	0.1262	0.2817	0.0645	0.042	0.520**	-0.1335	0.406*
DM rg				1	0.2683	0.2803	-0.0581	0.652**	0.784**	-0.0817	0.946**
Rp					1	0.0504	0.384*	0.0199	0.2512	0.340*	0.331*
NBPP rg					1	0.0495	0.819**	-0.510**	0.379*	0.837**	0.646**
Rp						1	-0.1328	0.0934	0.2225	-0.387*	-0.1692
NPPP rg						1	-0.324*	0.439*	0.3092	-0.570**	-0.0763
rp							1	0.0785	-0.0424	0.2127	0.0659
NCPP rg							1	0.643**	-0.0692	0.751**	0.461*
rp								1	0.0674	-0.2945	-0.217
SYPP rg								1	-0.797**	0.654**	-0.364*
rp									1	-0.266	**0.549****
BY rg									1	-0.360*	0.811**
rp										1	0.431*
HI rg										1	-0.0693
rp											1
YP rg											**1**

Table 7. Phenotypic and genotypic PATH matrix for yield per plot

	FE	50 % F	PH(cm)	DM	NBPP	NPPP	NCPP	SYPP	BY	HI	YP
rp	**0.6151**	-0.0833	0.0256	-0.0022	0.0568	0.0381	0.3895	-1.65	0.0678	-0.3994	-0.2694
FE rg	**0.1464**	-0.0331	-0.002	-0.0095	0.0337	0.0136	0.037	0.018	0.0143	-0.0038	0.1906
rp	**0.6151**	-0.0833	0.0256	-0.0022	0.0568	0.0381	0.3895	-1.65	0.0678	-0.3994	-0.2694
50%F rg	0.0811	**-0.3594**	-0.1791	0.0281	0.0019	-0.0997	0.0719	0.0982	0.0163	-0.0204	-0.269
rp	0.0172	-0.5392	**0.4137**	-0.1607	-0.5809	-0.1957	0.2608	0.841	-0.3662	0.0036	0.2277
PH rg	-0.0028	0.0712	**0.143**	0.0021	-0.0067	0.0213	-0.0303	-0.0035	0.0273	-0.0106	0.0503
rp	-0.0001	-0.0077	-0.0099	**0.0254**	0.0068	0.0071	-0.0015	0.0406	0.0199	-0.0021	0.946**
DM rg	-0.0131	-0.0158	0.003	**0.2015**	0.0254	0.0568	0.013	0.0085	0.1047	-0.0269	0.406*
rp	-0.0542	-0.2987	0.8247	-0.1576	**-0.5873**	-0.0291	-0.4812	0.2998	-0.2226	-0.4916	0.646**
NBPP rg	-0.0051	0.0001	0.001	-0.0028	**-0.0221**	-0.0011	-0.0085	-0.0004	-0.0055	-0.0075	0.331*
rp	-0.0426	-0.3718	0.3257	-0.193	-0.0341	**-0.6884**	0.2228	-0.3022	-0.2129	0.3927	-0.0763
NPPP rg	-0.0048	-0.0144	-0.0077	-0.0147	-0.0026	**-0.0521**	0.0069	-0.0049	-0.0116	0.0202	-0.1692
rp	0.0246	-0.0186	0.0245	-0.0023	0.0318	-0.0126	**0.0389**	0.025	-0.0027	0.0292	0.461*
NCPP rg	-0.0286	0.0227	0.024	-0.0073	-0.0435	0.0151	**-0.1134**	-0.0089	0.0048	-0.0241	0.0659
rp	-0.4474	-0.3711	1.6328	0.2663	-0.0851	0.0732	0.1073	**0.1668**	-0.1329	0.1788	-0.364*
SYPP rg	-0.0228	0.0506	0.0045	-0.0078	-0.0037	-0.0173	-0.0145	**-0.1853**	-0.0125	0.0546	-0.217
rp	0.2146	-0.0603	-1.7243	1.5268	0.7384	0.6022	-0.1348	-1.5523	**0.948**	-0.7014	0.811*
BY rg	0.0559	-0.0258	0.1092	0.2966	0.1433	0.127	-0.0242	0.0385	**0.5707**	-0.1518	0.549*
rp	-0.4623	0.1502	0.0062	-0.0582	0.596	-0.4061	0.5346	0.7631	-0.2564	**0.712**	-0.0693
HI rg	-0.0156	0.0342	-0.0446	-0.0803	0.2047	-0.2328	0.1279	-0.1771	-0.16	**0.6014**	0.431*
rp	-0.2694	-0.610**	0.2277	0.946**	0.646**	-0.0763	0.461*	-0.364*	0.811**	**-**0.0693	**1**
YP rg	0.1906	-0.2697	0.0503	0.406*	0.331*	-0.1692	0.0659	-0.217	0.549**	0.431*	**1**

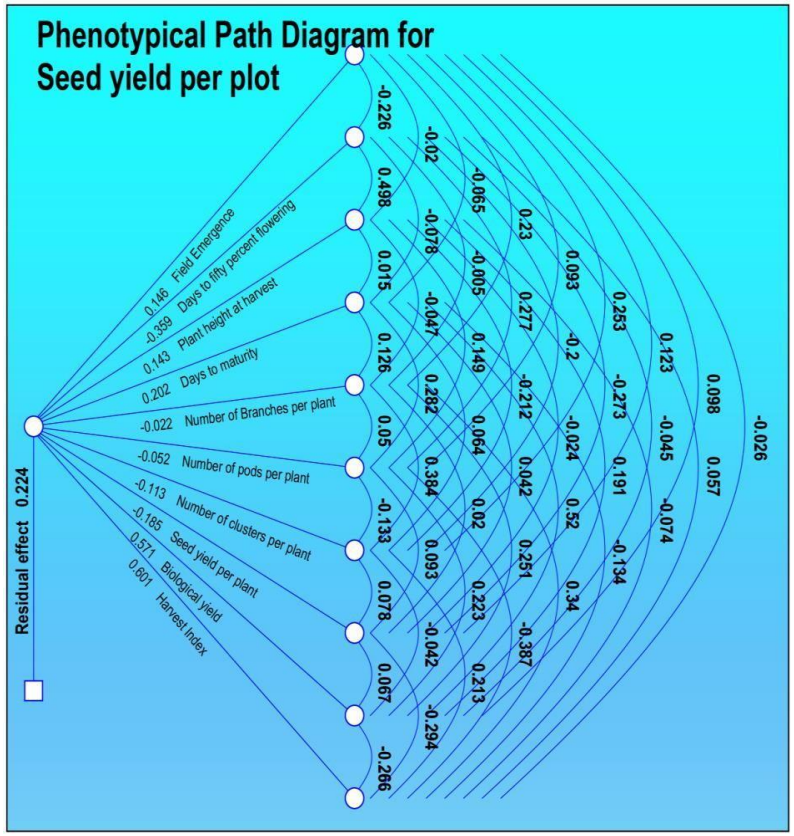

Fig. 3. Phenotypic path diagram for yield per plot

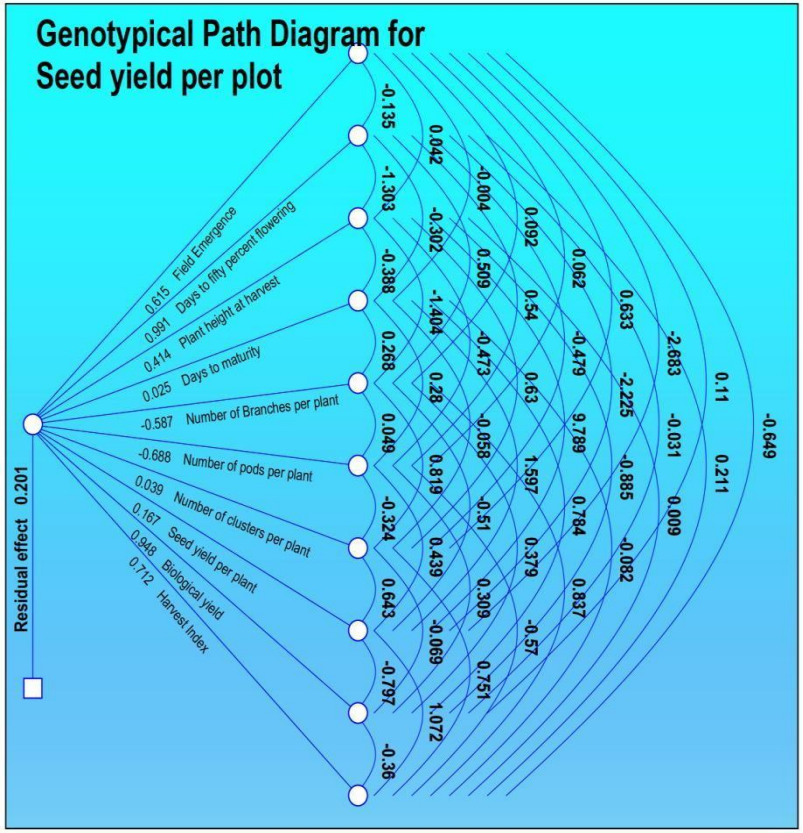

Fig. 4. Genotypic path diagram for yield per plot

4.CONCLUSION

In summary, it was observed that panchagavya@10% for 12 hours had a positive effect on the yield traits and seedling quality parameters in cluster beans. Seed treatment with panchagavya@10% for 12 hours showed best results in Field emergence percentage, Plant height (30, 60 & 90 DAS), Days to 50 % flowering, Number of branches per plant**,** Number of pods per plant, Number of clusters per plant, Days to maturity, Seed yield per plant (g), Seed yield per plot (g), Biological yield (g), Harvest index (%) and seed quality parameters like Germination percent (%), Germination Rate, Speed of Germination, Root length, Shoot length, Seedling length, Fresh weight of Seedling, Dry weight of Seedling, Seedling Growth Rate, Root: Shoot Ratio, Seed Metabolic Efficiency, Vigour Index-I, Vigour Index-II, Electrical Conductivity.

ACKNOWLEDGEMENT

Authors are thankful to the scientists and professors of department of Genetics and Plant breeding and department of Physics, SHUATS, Prayagraj for their continuous guidance and timely support to carry out this experiment successfully.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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