Original Research Article

RESPONSE OF DIFFERENT PRE-SOWING SEED TREATMENTS WITH BIOFERTILIZERS, PLANT GROWTH REGULATORS AND BOTANICAL EXTRACT ON GROWTH AND YIELD PARAMETERS OF FIELD PEA (*Pisum sativum*.L)

Comment [J51]: *Pisum sativum* L.

Abstract

A field experiment was conducted during *rabi* season in the year (2021-2022) at post graduate Central Research Farm, Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The soil of experimental plot was sandy loam in texture, (pH 7.1), in order to study the different Pre-sowing Seed Treatments of Field pea var. Rachana. The experiment was laid out in Randomized Block Design(RBD) with 13 treatments and 3 replications. Pea seeds were treated with (NAA, GA_3, Rhizobium, Azatobacter, Neem Leaf Extract, Lantana Camera Extract) were subjected to growth and yield parameters. The results reported that seed treatment with treatment (T_2) (NAA@100 ppm for 12hours) recorded highest germination percentage, maximum plant height, minimum days for 50% flowering and days to pod maturity, maximum number of branches/plant, number of pods/plant, Number of seeds/pod, highest pod length and pod width, maximum seed yield, biological yield, harvest index was significant in all and highest gross returns, net returns and cost benefit ratio was recorded in treatment (T_2) seed treatment with NAA@100ppm for 12hours.

Comment [J52]: No need for any parentheses

Comment [J53]: showed

Comment [J54]: the highest

Keywords: *Field Pea, Biofertilizers, Plant Growth Regulators, Botanicals*

Comment [J55]: Botanical Extract

UNDER PEER REVIEW

INTRODUCTION

Field pea (*Pisum sativum L.*) is one self-pollinated diploid (2n=14) annual of the most important annual cool season pulse crop and is valued as high protein food. It is widely grown in the cooler temperate zones and in the highlands of tropical regions of the world.

Comment [J56]: Too convoluted that it lost its actual meaning. Try to make it into two sentences.

Field pea (Pisum sativum L.), a legume crop, belongs to the Leguminosae family and contains a high amount of protein including amino acids, especially lysine (**Nawab *et***

***al*.,2008**). Beans are considered to be the most nutritious part of the human diet because they contain 42.65% carbohydrates, 27.8% protein and iron (Fe), sodium (Na), phosphorus (P), potassium (K), and some other important elements (**Amna., 2020**). They provide 22-24 per cent protein and the seeds are considered easily digestible and the increasing demand of protein rich raw material for animal feed or intermediary product for human nutrition, there is raising interest in these crops as a protein source (**Santalla *et al*., 2001**).

Comment [J57]: Try to make it into two sentences.

In India, Total pulse production is 25.23 M tonnes (2017-18) total area under pea production is 9.01 lakh ha and total production of 8.49 lakh tons were recorded. In India Uttar Pradesh ranked first both in area and production (37.90% and 41.58%). In Karnataka, area and production is about 1.54 thousand ha and 20.37 thousand tonnes respectively, with a productivity of 13.26 t/ha (**Anonymous, 2016**).

Application of growth promoting hormones is a recent technique in this direction. Plant hormones in a broad sense are organic compounds which play an important role in plant growth development and yield of crops to prevent the fruit and flower drop for a longer period. The plant growth regulators are organic compounds, other than nutrients which in small concentration influence the physiological processes of plants. They have been used for various beneficial effects such as promoting root growth, increasing number of flowers, fruit size and inducing early and uniform fruit ripening. NAA (Naphthalene Acetic Acid) in the synthetic auxin with the identical properties to that naturally occurring auxin. It prevents formation of abscission layer and there by flower drop. Plant growth regulators are used widely to improve plant performance, GA3 (Gibberellic acid) is one of those growth regulators that have positive effect on plant growth rate through the effect on cell division and elongation **Batlang *et al*., (2006)**. Biofertilizers are natural fertilizers containing micro-organism which help in enhancing the productivity by Biological nitrogen fixation or solubilization of insoluble phosphate or producing hormones, vitamins and other growth regulators required for plant growth (**Bhattacharya, 2000**). Biofertilizer is a natural product carrying living micro-organisms derived from the root or cultivated soil. A small dose of Biofertilizer is sufficient to produce desirable results because each gram of carrier of biofertilizers contains at least 10 million viable cells of a specific strain (**Anandaraj and Delapierre, 2010**). Among the various fertilizers, biofertilizers are important sources of nutrients. *Rhizobium* inoculation increased the root nodulation through better root development and more nutrient availability, resulting in vigorous plant growth and dry matter

UNDER PEER REVIEW

production which resulted in better flowering, fruiting and pod formation and ultimately there was beneficial effect on seed yield (**Sardana *et al.*, 2006**). The favorable effect of *Azotobacter* and mineral nitrogen fertilizer on growth, chemical composition of leaves, and yield was reported on pea indicated that both inoculation with *Azotobacter* and application of N increased seed yield (**Verma *et al.*,2000**). Many botanical extracts have been studied on seed and seedling characters, they gain much importance in growth, yield and quality parameters. Seed treatment with neem leaf extract and lantana camera extract effect can be seen in growth and yield of a plant. Botanical seed treatment is extracted from naturally occurring sources based on botanical ingredients. It has a synergistic effect on early and uniform seed germination and enhances tolerance to pest and disease during early crop stage.

The objective of this study is to determine the response of different doses of selected biofertilizers, plant growth regulators and botanical extracts on growth and yield parameters for field pea.

To identify suitable pre sowing seed treatments favorable for field pea.

To estimate the benefit cost ratio for field pea.

Comment [J58]: The position of the paragraph should be consistent with previous ones.

2. MATERIALS AND METHODS

2.1. Description of study area

The experiment was conducted during *Rabi* season of 2021-22. The experiment was conducted using Randomized Block Design consisting of 13 treatments with three replication in field condition at the department of Genetics & Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. Prayagraj is located in the south eastern part of Uttar Pradesh, India. This region has subtropical Climate with extreme of summer and winter. The temperature falls to as low as 2-3^{0}c during winter season especially in the month of December and January.

2.2 Experimental design and treatment details

T_0 - CONTROL

T_1, T_2 - NAA @ 50, 100ppm for 12 hours

UNDER PEER REVIEW

T_3, T_4 - GA_3 @ 50, 100ppm for 12 hours

T_5, T_6 - Rhizobium @ 50,100g for 12 hours

T_7, T_8 - Azatobacter @ 40,80g for 12 hours

T_9, T_{10} - Neem leaf extract @ 5, 10% for 12 hours

T_{11}, T_{12} - Lantana camera extract @ 5, 10% for 12 hours

From the sowing till the physiological maturity and harvest the observations were recorded on different growth parameters viz field emergence on 4^{th} day, 7^{th} day, 10^{th} day, days for 50% flowering, days to pod maturity, plant height at 30days, 60days, 90days, number of branches per plant and yield parameters viz number of pods per plant, number of seeds per plant, pod length, pod width, seed yield per plant, seed yield per plot, seed yield per hectare, biological yield, harvest index were recorded and statistically analyzed using analysis of variance as applicable to randomized block design. Field pea was harvested 90% when pods turns in brown colour. Five random plants were selected in each plot of all replications.

RESULTS AND DISCUSSION

A. Growth parameters

The maximum germination % on 4^{th} day was recorded in treatment T_2 NAA @ 100ppm for 12 hours is (17.33) on 7^{th} day (65.33) and on 10^{th} day (89.33) and followed by T_4 GA_3 @100ppm which was significantly superior over all other treatments and whereas the lowest was found in treatment T_0 (0.00)on 4^{th} day, (14.67) on 7^{th} day and (52.00) on 10^{th} day. Similar results was observed by **Tharunasree *et al.*,(2021)** showed that seed treatment with NAA@ 100ppm recorded the highest germination percentage in field pea.

Days to 50% flowering in field pea was observed that significantly minimum days in days to 50% flowering and days to pod maturation found in the treatment T_2 NAA @ 100ppm for 12 hours where seeds may be considered as the best treatment for early period in days to 50% (45.33) and the minimum days taken for pod maturity in the field pea was observed from the date of sowing seeds to the physiological maturity of pea seeds. The early pod maturation period was found in treatment T_2 NAA @ 100ppm for 12 hours (96.00) and followed by T_4 GA_3 @100ppm (64.00) the maximum days was recorded in treatments T_0 (55.67) in days to 50% flowering in field pea and (104.33) in days to pod maturation. Similar results were confined by

UNDER PEER REVIEW

Chandiniraj *et al*.,(2016) in chilli, **Sanodiya.,(2017)** in okra and **Tharunasree *et al*.,(2021)** in field pea**.**

The highest plant height in our experiment found on 30, 60, 90 DAS was recorded in treatment T_2 NAA @ 100ppm for 12 hours (30.99)cm on 30 days and (72.75)cm was found in 60 days and (121.92)cm was found in 90 days after sowing which was significantly superior over all other. In case of branches per plant of pea is significantly increase in number of branches per plant which was recorded in the treatment T_2 NAA @ 100ppm for 12 hours (11.33) whereas the lowest in all different stages of plant height and number of branches per plant was found in treatment T_0 control. Similar results were observed by **Mondal (2003)** in groundnuts, **Samsuzzaman (2004)** in ground nuts**, Chakma (2005)** in mung bean, **Singh *et al*.,(2015)** showed that NAA at 45ppm recorded highest height in pea, **Foysalkabir *et al*.,(2016)** in mungbean, **Tharunasree *et al*.,(2021)** in field pea.

B. YIELD PARAMETERS

The number of pods per plant are significantly maximum in pods per plant and number of seeds per pod in the treatment T_2 NAA @ 100ppm for 12 hours (25.27) and (6.70) respectively and minimum number of pods and number of seeds per pod were recorded in treatment untreated T_0. Similar results were confined with work of **Khanzada *et al*.,(2002)** who stated that application of NAA increased number of seeds per pod, **Anonymous (2003)** in green gram, **Pandey *et al*.,(2004)** observed that maximum number of seeds was obtained with application of NAA 1500ppm in pea, **Chakma (2005)** in mung bean, **Asaduzzaman.(2013)** in green gram**, Aslam *et al*., (2010)** in chickpea, **Singh *et al*.,(2015)** in pea, **Tharunasree *et al*., (2021)** in field pea**.**

The length of pods of five random selected plants from each plant were measured. Significantly maximum pod length and pod width was found in the treatment T_2 NAA @ 100ppm for 12 hours (5.73) and (1.45) respectively. The minimum in both was recorded in treatment T_0 untreated seeds. These observations were consistent with the results of **Upadhyay (2002)** in chickpea, **Anonymous (2003** in green gram, **Das and Prasad (2003)** found that application of NAA at 20ppm pod length in mung bean**, Chakma (2005)** in mung bean, **Asaduzzaman (2013)** showed that NAA at 20ppm has significant effect on length of pod in green gram, **Kumanan *et al*.,(2020)** showed that NAA@100ppm obtained the maximum pod length and pod width in lab lab.

UNDER PEER REVIEW

As number of pods increases the yield increases. Significantly maximum seed yield per plant, seed yield per plot and seed yield per hectare was found in the treatment T_2 NAA @ 100ppm for 12 hours (18.73), (317.73) and (18.20) respectively and followed by GA_3 @100ppm. Miniumum seed yield in field pea was recorded in untreated control seeds in treatment T_0. It implied that NAA decreases the dropping of flower, pod forming and increased in number of pods and seed yield. Similar results was observed by **Mondol (2003)** in groundnuts, **Pandey.,(2004)** reported the increase in yield by application of NAA 1500ppm on pea, **Samsuzzaman (2004)., Singh and lal (2002)** found the maximum number of fruits per plant by NAA **Chakma (2005)** in mung bean, **Asaduzzaman.(2013)** in green gram and **Tharunasree *et al*., (2021)** in field pea**.**

The seed yield and dry plant weight of the pea plant both weighed and recorded. Significantly the maximum biological yield per plot was found in the treatment T_2 NAA @ 100ppm for 12 hours (666.80). The minimum biological yield was recorded in untreated control seeds T_0 (465.10). Similar results was found by **Upadhyay (2002)** in chickpea**, Asaduzzaman (2013)** showed that NAA @20ppm have a significant effect on biological yield in green gram, **Deepak gupta *et al*.,(2019)** showed that maximum biological yield was reported in NAA@75 ppm in green gram and **Tharunasree *et al*., (2021)** in field pea**.**

Significantly maximum percent of harvest index was observed in the treatment T_2 NAA @ 100ppm for 12 hours (47.67) with grand mean (45.57). The minimum percent of harvest index per plot is found in untreated seed treatment T_0 (41.67). The results were agree with **Anonymous (2003)** in green gram**, Chakma (2005)** found that the foliar application of 120ppm NAA showed significantly increase in harvest index in mung bean, **Aslam *et al*., (2010)** indicated that NAA have a significant effect on harvest index in chickpea, and **Tharunasree *et al*., (2021)** found that NAA @100ppm showed maximum harvest index in field pea**.**

UNDER PEER REVIEW

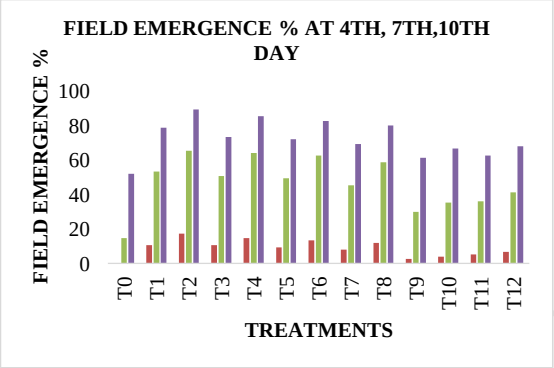

Fig1: Response of different treatments on Field emergence on 4th, 7th and 10th day.

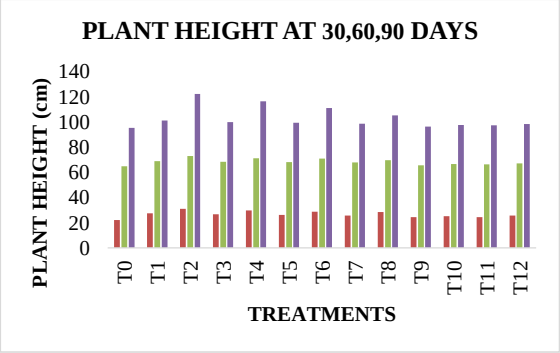

Fig2: Response of different treatments on plant height on 30, 60, 90 days

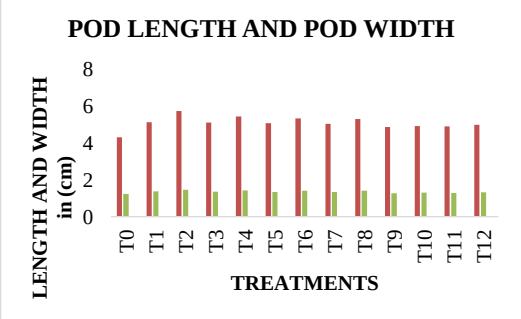

Fig3: Response of different treatments on pod length and pod width

UNDER PEER REVIEW

CONCLUSION

Plant growth regulators promotes germination, early growth rapid seed germination and seed development. It is concluded that NAA gave best results to enhance early seed emergence, plant height, early flowering and good seed yield. Therefore, it can be concluded that application of NAA @100ppm for 12 hours significantly recorded highest seed yield (18.20t/ha), higher gross returns (Rs1,82,000/ha), net returns (Rs1,43,999/ha) and benefit cost ratio (3.78) as compared all other treatments. Since all these findings are based on the research done in *rabi* season in SHUATS, U.P.

Table1.1: Analysis of Variance for response of treatments on growth and yield parameters in field pea.

Characters	Mean sum of square		
	Replications (df=2)	Treatments (df=12)	Error (df=24)
Field emergence percentage at 4th day	5.33	75.15*	3.56
Field emergence percentage at 7th day	21.33	672.67*	10.00
Field emergence at 10th day	54.56	338.12*	42.12
Days to 50% flowering	0.18	23.36*	3.15
Days to pod maturity	1.14	19.77*	3.20
Plant height at 30 DAS	0.75	18.37*	0.34
Plant height at 60 DAS	2.84	16.61*	0.97
Plant height at 90 DAS	20.29	223.72*	6.40
Number of branches per plant	1.24	4.86*	0.46
Number of pods per plant	4.88	17.83*	2.07
Number of seeds per pod	0.05	1.00*	0.12
Pod length	0.35	0.01*	0.00
Pod width	0.00	0.01*	0.00
Seed yield per plant	1.42	4.68*	0.42
Seed yield per plot	133.83	3026.91*	52.33
Seed yield per hectare	0.18	16.40*	0.50
Biological yield	192.63	8389.77*	107.49
Harvest index	0.54	7.40*	0.51

At 5% level of significance

Table: 1.2 Mean performance of growth parameters in field pea

Sl. NO.	Treatments	Field Emergence % at 4th day	Field emergence % at 7th day	Field emergence % at 10th day	Days to 50% flowering	Days to pod maturity	Plant height at 30 DAS (cm)	Plant height at 60 DAS (cm)	Plant height at 90 DAS (cm)	Number of branches per plant

UNDER PEER REVIEW

1	**T_0**	**0.00**	**14.67**	**52.00**	**55.67**	**104.33**	**21.93**	**64.67**	**95.20**	**6.30**
2	**T_1**	10.67	53.33	78.67	48.67	99.63	27.33	68.82	101.00	9.53
3	**T_2**	**17.33**	**65.33**	**89.33**	**45.33**	**96.00**	**30.99**	**72.75**	**121.92**	**11.33**
4	**T_3**	10.67	50.67	73.33	49.67	99.77	26.57	68.13	99.75	9.13
5	**T_4**	14.67	64.00	85.33	46.00	96.77	29.73	71.02	116.31	10.33
6	**T_5**	9.33	49.33	72.00	50.00	100.50	26.03	68.04	99.14	9.00
7	T_6	13.33	62.67	82.67	50.67	98.00	28.56	70.85	110.95	9.70
8	**T_7**	8.00	45.33	69.33	50.33	101.77	25.68	67.69	98.51	8.80
9	**T_8**	12.00	58.67	80.00	48.00	99.20	28.35	69.46	105.07	9.60
10	**T_9**	2.67	30.00	61.33	53.33	103.57	24.30	65.47	96.28	7.57
11	**T_{10}**	4.00	35.33	66.67	51.33	102.27	24.99	66.43	97.51	8.47
12	**T_{11}**	5.33	36.00	62.67	52.00	102.77	24.33	66.16	97.23	7.87
13	**T_{12}**	6.67	41.33	68.00	50.67	101.80	25.55	67.04	98.06	8.63
Grand Mean		**8.82**	**46.67**	**72.41**	**50.12**	**100.49**	**26.48**	**68.19**	**102.84**	**8.94**
C.D. (5%)		3.18	5.33	10.94	2.99	3.01	0.98	1.66	4.26	1.15
SE (m)		1.09	1.83	3.75	1.02	1.03	0.34	0.57	1.46	0.39
SE (d)		1.54	2.58	5.30	1.45	1.46	0.47	0.80	2.07	0.56
C.V.		21.38	6.78	8.96	3.54	1.78	2.19	1.45	2.44	7.61

UNDER PEER REVIEW

Sl. NO.	**Treatments**	**Number of pods per plant**	**Number of seeds per pod**	**Pod length (cm)**	**Pod width (cm)**	**Seed yield per plant (g)**	**Seed yield per plot (g)**	**Seed yield per hectare (t/ha)**	**Biological yield per plot (g)**	**Harvest index(%)**

1	**T_0**	**15.93**	**4.73**	**4.30**	**1.23**	**14.41**	**191.50**	**10.57**	**465.10**	**41.67**
2	**T_1**	20.47	6.20	5.13	1.37	17.48	288.93	15.90	636.07	45.41
3	**T_2**	**25.27**	**6.70**	**5.73**	**1.45**	**18.73**	**317.73**	**18.20**	**666.80**	**47.67**
4	**T_3**	19.87	6.03	5.10	1.36	17.19	287.67	15.57	626.40	45.12
5	**T_4**	22.80	6.47	5.44	1.43	18.32	306.00	17.20	657.20	46.55
6	**T_5**	19.23	5.93	5.07	1.34	16.76	284.70	13.97	616.63	46.16
7	T_6	21.57	6.37	5.34	1.41	17.83	299.03	17.00	651.93	45.86
8	**T_7**	18.93	5.80	5.03	1.33	16.60	282.10	13.77	610.07	46.23
9	**T_8**	20.73	6.33	5.29	1.40	17.61	293.93	16.70	642.70	45.74
10	**T_9**	17.60	5.10	4.86	1.26	15.32	250.93	12.03	569.27	44.07
11	**T_{10}**	18.37	5.47	4.92	1.30	15.85	276.13	13.13	592.37	46.66
12	**T_{11}**	17.83	5.37	4.89	1.28	15.61	254.63	12.17	576.00	44.21
13	**T_{12}**	18.70	5.67	4.99	1.32	16.50	281.10	13.57	595.63	47.18
Grand Mean		**19.79**	**5.85**	**5.08**	**1.34**	**16.78**	**278.02**	**14.59**	**608.16**	**45.60**
C.D. (5%)		2.42	0.59	0.32	0.06	1.09	12.19	1.19	17.47	1.20
SE (m)		0.83	0.20	0.11	0.02	0.37	4.18	0.41	5.99	0.41
SE (d)		1.17	0.29	0.16	0.03	0.53	5.91	0.58	8.47	0.58
C.V.		7.27	6.01	3.79	2.46	3.86	2.60	4.84	1.70	1.57

Table:1.3 Mean performance of yield parameters in field pea

Table:1.4 Gross returns, Net returns and Benefit cost ratio

UNDER PEER REVIEW

Treatments	Cost of treatments (Rs/ha)	Cost of cultivation (Rs/ha)	Total cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
T_0	0	33,001	33,001	52,833.33	19832.33	0.60
T_1	2,500	33,001	35,501	1,59,000.00	123499.00	3.47
T_2	5,000	33,001	38,001	1,82,000.00	143999.00	3.78
T_3	2,525	33,001	35,526	1,55,666.67	120140.67	3.38
T_4	5,050	33,001	38,051	1,72,000.00	133949.00	3.52
T_5	1,860	33,001	34,861	1,39,666.67	104805.67	3.00
T_6	3,720	33,001	36,721	1,70,000.00	133279.00	3.62
T_7	1,240	33,001	34,241	1,37,666.67	103425.67	3.02
T_8	2,480	33,001	35,481	1,67,000.00	131519.00	3.70
T_9	2,380	33,001	35,381	1,20,333.33	84952.33	2.40
T_{10}	4,670	33,001	37,671	1,31,333.33	93662.33	2.48
T_{11}	1,820	33,001	34,821	1,21,666.67	86845.67	2.49
T_{12}	3,640	33,001	36,641	1,35,666.67	99025.67	2.70

UNDER PEER REVIEW

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCES

Amna.(2020).Screening of resistant germplasm against powdery mildew of pea and its management through nutrients and plant activators. *Asian J Agric Biol*.; 8: 85-91.

Anandaraj.B. and L.R.A. Delapierre, (2010). Studies on influence of bioinoculants (Pseudomonas fluorescens,Rhizobium sp., Bacillus megaterium) in green gram.*J. Biosci. Technol*., 1: 95-99

Anonymous.(2003). Food and Agriculture Organization (FAO), Rome, Italy.(http://faostat.fao.org).

Anonymous, (2016), Indian horticulture database, http:*www.nhb.gov.in*

Asaduzzaman, M. (2013). Effect of variety and NAA on water relations and yield of mungbean in kharif-II season. M.S. Thesis. Dept. Agron., Sher-e-Bangla Agric. Univ., Dhaka.

Batlang V, Emongor VE and Pule-Meulenburg F. (2006). Effect of benzyladenine and gibberellic acid on yield and yield components of cucumber (*Cucumis sativus* L.). *Journal of Agronomy*. 5:418-423.

Bhattacharya, S. K. (2000) Current facets in potato research Proceed Souvenir and Abstracts, National Seminar, Indian Potato Association, C.P.R.S., Modipuram Mcerut, Dec. 13-15. pp. 8-9.

Chakma, T.M. (2005). Effect of NAA on growth, yield & yield attributes of mungbean. M.S. Thesis, Dept. Crop Bot., Bangladesh Agril. Univ., *Mymensingh.*

Chandiniraj A, Holebasappa K, Hre JK, Chattopadyay N.(2014). Growth and yield of chilli as influenced by different growth regulators, *The bioscan An Interntional Jounal of Life Science*.11(1):385-388

Das, A. and Prasad, R. (2003). Effect of plant growth regulator CCC and NAA on the growth and yield of summer mungbean. *Ann. Agril. Res*. 24(4): 874- 87

UNDER PEER REVIEW

Deepak Gupta, Prashant Kumar Rai,Abhishek Kumar Pal.(2019). Effect of plant growth regulators on growth, yield and yield attributing traits of green gram (*Vigna radiata* L). *International Journal of Chemical Studies* 7(3): 4483-4485

Foysalkabir, A.K.M., Islam, S.M. and Quamruzzaman, M. (2016). Effect of Plant Growth Regulator and Row Spacing on Mungbean [*Vigna radiata* (L.) Wilczek]. *Adv. Biol. Res*., 10(4): 222-229, 2016.

G.L.Sai Tharuna Sree, Abhinav Dayal and Prashant Kumar Rai.(2021) Influence of different pre – sowing seed treatments with organic, growth regulators & chemicals on growth, yield and yield attributing traits in field pea (*Pisum sativum*).*Advanced journal of Seed Science and Technology*, Vol.7(3),pp. 242-246.

Kanhaiyalal Sanodiya, Geeta Pandey, Prafull Kacholli and Ashish Kumar Dubey.(2017). Effect of growth regulator on growth, yield and seed quality parameters of okra (*Abelmoschus esculentus* L.) cv. Utkal Gaurav. *International Journal of Current Microbiology and Applied Sciences* 6(10): 3551-3556.

Khanzada, A., M. Jamal, M.S. Baloch and K. Nawab. (2002). Effect of naphthalein acetic acid (NAA) on yield of soybean. *Pak. J. Biol. Sci*. 3 (5): 856-857.

K Kumanam, M Manikandan and T Saraswathi.(2020). Impact of plant growth regulators in lab Lab (*Dolichus lablab* L.) on yield and yield contributing characters. *The pharma Innovation Journal* Vol9(12): 27-29

Mondol, M.M. (2003). Effect of NAA & IBA on growth and yield of groundnut. M.S. Thesis, Dept. Crop Bot., Bangladesh Agril. Univ., *Mymensingh*. 83pp.

Muhammad Aslam, Ejaz Ahmad, A.G. Saguu, Khalid Hussain, Muhammad Ayaz, Inayat Ullah, Amir Hussain and Himayatullah.(2010). Effect of plant growth regulators and available soil moisture depletions on yield and yield components of chickpea. *Sarhad J.Agric*. Vol.26, No.3

Nawab NN, Subhani GM, Mahmood K, Shakil Q, Saeed A.(2008). Genetic variability, correlation and path analysis studies in garden pea (*Pisum sativum* L.). *J Agric Res*. 2008.

UNDER PEER REVIEW

Pandey, A. K., Tiwari, S. K., Singh P. M. and Rai, M. (2004). Effect of GA3 and NAA on vegetative growth, yield and quality of Garden pea (*Pisum sativum* L.) ssp. hortense asch and graebn). *Veg. Sci*. 31(1): 63-65.

Samsuzzaman, M. (2004). Effect of GABA & NAA on growth and yield contributing characters of groundnut. M.S. Thesis, Dept. Crop Bot., Bangladesh Agril. Univ., *Mymensingh. p*. 42.

Santalla, M., Amurrio,J.M. and De Ron, A.M. (2001). Food and feed potential breeding value of green, dry aand vegetable pea germplasm. Canadian Journal of Plant Science 81:601-610.

Sardana V, Sheoram P and Singh S. (2006) *Indian Journal of Pulses Research*,19: 216.

Shohag, M.J.I., Karim, M.A. and Rahman, M.S. (2008). Effect of growth regulator on morphological attributes of mungbean under irrigated and non-irrigated conditions*. J. Agrofor. Environ*., 2(1): 1-6, 2008.

Singh, D.K. and Lal. G.(2002). Effect of plant bio-regulators on the growth and yield of tomato (*Lyco. EsculentumMill*.). *Prog.Hort*. 33,1:60-64.

Singh, M., John, S. A., Rout, S. and Patra, S. S.(2015).Effect of GA_3 and NAA on growth quality of garden pea (*Pisum sativum* L.) cv Arkel. *The Bioscan*. 10(3): 381-383.

Upadhayay, R.G. (2002). Effect of bio-regulators on growth development, flowering behavior and yield of chickpea. *Legume Res*., 17(1): 60-62.

Verma O.P., P. Sangeeta, M.S. Rathi and S. Paul, (2000) Synergistic effect of co-inoculation of Azotobacter chrooccum and Rhizobium on pea (*Pisum sativum*).

UNDER PEER REVIEW