Effect of seaweed extracts on growth, yield parameters in Chickpea (*Cicer arietinum.L*)

ABSTRACT

This field experiment entitled "Effect of seaweed extracts on growth, yield parameters in Chickpea (Cicer arietinum.L)" was conducted during rabi at Field Experimentation Centre of the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, Uttar Pradesh, India during 2019 & 2020. The experiment was consisted of 2 varieties and 14 treatments comprising of seaweed extracts (i.e., Ascophyllum nodosum, red and brown algae) which was laid in RBD (Randomized Block Design) with kabuli & desi chick pea, 14 treatments, 03 replications. The results shows that among all the treatments, the genotypes kabuli & desi chickpea treated with 2.0% A. nodosum for 6 hours recorded the maximum value in growth parameters such as percent field germination after four (10.74 & 10.74), seven (49.26 & 47.41), and ten (77.41 & 70.74) DAS, Days to 50% flowering (88.67 & 86.00), days to maturity (154.00 & 156.33), number of branches 25 (17.93 & 16.60) and 50 DAS (36.70 & 33.57) and height at 25 (4.47 & 3.93) and 50 (7.27 & 7.00) DAS. Similar results were also recorded in different yield parameters in both kabuli & desi chickpea genotypes such as number of pods plant (61.52 & 60.24), number of pods per plot (1025.67 & 922.00), number of seeds per plant (102.5 & 100.4), number of pods per plant (14.25 & 1525), seed yield per plant (28.30 & 25.35), seed yield per plot (358.44 & 328.86), biological yield (3187.42 & 3061.24), economical yield (1341.67 & 1231.33), and harvest index showing most superior values when treated with treatment 2.0% Ascophyllum nodosum for 6 hours. Remaining treatments i.e, treatment with 0.5% Ascophyllum nodosum solution, 1.0% Ascophyllum nodosum solution, 0.5% red and brown algae solution, 1.0% red and brown algae solution, 2.0% red and brown algae solution for 6 hours recorded the second most effective (best?) (Should be unitized to Conclusion) treatments observed significantly superior than untreated checks.

Keywords: *Ascophyllum nodosum*, Chickpea, red and brown algae.

Introduction

Chickpea (*Cicer arietinum* L.) belongs to Fabaceae family. It is self pollinated and true diploid (2n=2x=16) in nature. In the world, chickpea stands third most important legume. In the world, India is one among the pulse producing countries. 62-67 percent of total production in globe was contributed by India. Among the countries in world, though India is one of the largest country in pulse production, to meet annual domestic consumption, 2-3 million tons of pulses are imported annually. The current per capita availability of pulses as 80 g /day, recommended by FAO is very low that can't meet the per capita requirement. Chickpea contains low cholesterol, sodium, fat and high fibre contents. Chickpea also a rich sourse of protein and minerals. 100g of boiled chickpea contains energy- 164 calories, fat– 2.6 g (in which only 0.27g fat is saturated), dietary fibre– 7.9g, protein–8.9g and dietary calcium–49 to 53mg/100g. Chickpea used in both human and animal consumption. Seaweeds are marine algae, that are macroscopic and found attached at the bottom of shallow coastal waters. Marine algae that grows upto 180 meters depth in intertidal, deep and shallow waters and also grows on solid substrates like rocks, pebbles and dead corals in back waters. The extracts of seaweed has beneficial effects on germination of seeds and on growth of the plant (Bhosle *et al.*, 1975; Kumar *et al.*, 1994). Verklejj (1992) reported that, on application of liquid seaweed fertilizer to soil enhances the water retention

capacity. Extracts of seaweed enhance antioxidant properties (Verkleij, 1992), contains amino acids, vitamins, cytokinins, auxins, major & minor nutrients and abscisic acid, that acts as growth promoting substances that promotes growth, yield and develops tolerance against environmental stress in plants (Zhang *et al.*, 2003), increase soil nutrient uptake (Turan and Kose, 2004). From marine algae, bioactive substances are extracted, used in agricultural and horticultural crops and many beneficial effects on yield and quality enhancement can be achieved. Now-a-days, in many crops including pulses, cereals and vegetable crops, using liquid seaweed extracts as foliar sprays has gained importance. Than chemical fertilizers, seaweed extracts are free from toxins, biodegradable, pollution free and safe to human, animals and birds (Dhargalkar and Pereira, 2005).

MATERIALS AND METHODS:

This Research work was carried out at experimental field during rabi season 2019-2020. Department of Genetics and plant breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The experiment was consisted of 2 varieties and 14 treatments comprising of seaweed extracts (i.e., *Ascophyllum nodosum* , red and brown algae).

Preparation of Sea Weed Extract Solution: For preparing Sea weed extract solution, measure 5ml, 10ml, 20ml Sea weed extracts in a beaker and add 1000 ml distilled water by constant stirring. The final volume made up to one litre, and then it became 0.5%, 1.0%, 2.0% stock solution of Sea weed extracts.

The treatments were represented as T0- Desi Chickpea Control (Untreated), T1- Desi seeds treated with 0.5% *Ascophyllum nodosum* solution @ 6 hours, T2-Desi seeds treated with 1.0% *Ascophyllum nodosum* solution @ 6 hours, T3-Desi seeds treated with 2.0% *Ascophyllum nodosum* solution @ 6 hours, T4-Desi seeds treated with 0.5% red and brown algae solution @ 6 hours, T5-Desi seeds treated with 1.0% red and brown algae solution @ 6 hours, T6-Desi seeds treated with 2.0% red and brown algae solution @ 6 hours, T7-Kabuli Chickpea Control (Untreated), T8-kabuli seeds treated with 0.5% *Ascophyllum nodosum* solution @ 6 hours, T9-kabuli seeds treated with 1.0% *Ascophyllum nodosum* solution @ 6 hours, T10-kabuli seeds treated with 2.0% *Ascophyllum nodosum* solution @ 6 hours,T11-kabuli seeds treated with 0.5% red and brown algae solution @ 6 hours, T12-kabuli seeds treated with 1.0% red and brown algae solution @ 6 hours, T13-kabuli seeds treated with 2.0% red and brown algae solution @ 6 hours.

The data recorded during the course of the investigation will be subjected to Statistical Analysis by 1 X 1 RBD, as per the method “Analysis of Variance (ANOVA) technique”. Experiment will be laid out in RBD and the treatments will be replicated three times. The significant and non-significant effect was judged with the help of “F” (variance ratio) table. The significant difference between the means was tested against the critical difference of 5% level. For testing the hypothesis, ANOVA table was used.

RESULTS AND DISCUSSION:

Highest field germination percentage after four, seven and ten days of treatment application in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) with 10.74, 49.26 & 77.41 percent and was found statistically at par with treatment T9 (1.0% *Ascophyllum nodosum* solution) with

10.37, 44.44 & 72.22 percent and T8 (2.0% red and brown algae solution) with 9.26, 43.33 & 70.00 percent respectively.

The highest days to 50% flowering and days to maturity in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) i.e., 88.67 & 156.33 days and was found at par with treatment T8 (0.5% *Ascophyllum nodosum* solution) and T9 (1.0% *Ascophyllum nodosum* solution) with 85.00 & 151.67 and 84.33 & 149 days respectively whereas in desi chickpea genotypes the application of treatment T2 (1.0% *Ascophyllum nodosum* solution) & T3 (2% *Ascophyllum nodosum* solution) recorded highest days to 50% flowering & maturity with 87.00 & 154.00 days.

The maximum plant height after 25 & 50 days of sowing and treatment application in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) with 17.93 & 36.70 and was found statistically at par with treatment T9 (1.0% *Ascophyllum nodosum* solution) with 16.87 & 34.73 whereas, in desi chickpea genotypes the application of treatment T3 (2% *Ascophyllum nodosum* solution) recorded highest plant height with 16.60 & 33.57 and was found statistically at par with treatment T2 (1% *Ascophyllum nodosum* solution) with 13.87 & 26.60.

The maximum number of branches after 25 & 50 days of sowing and treatment application in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) with 4.47 & 7.27 branches and was found statistically at par with treatment T9 (1.0% *Ascophyllum nodosum* solution) with 4.07 & 6.80 branches whereas, in desi chickpea genotypes the application of treatment T3 (2% *Ascophyllum nodosum* solution) recorded highest number of branches with 3.93 & 7.00 branches and was found statistically at par with treatment T2 (1.0% *Ascophyllum nodosum* solution) with 3.27 & 5.60 branches.

The maximum numbers of pods per plant & pods per plot after sowing and treatment application in kabuli genotype was observed in treatment T10 (2.0% *Ascophyllum nodosum* solution) with 61.55 pods/ plant & 1025.67 pods/ plot and was found statistically at par with treatment T9 (1.0% *Ascophyllum nodosum* solution) with 56.20 pods/ plant & 860.33 pods/ plant respectively whereas, in desi chickpea genotypes the application of treatment T3 (2% *Ascophyllum nodosum* solution) recorded highest number of pods with 60.24 pods/ plant & 922.00 pods/ plot and was found statistically at par with treatment T2 (1.0% *Ascophyllum nodosum* solution) 57.31 pods/ plant & 901.33 pods/ plot.

The maximum number of seeds per plant & seeds per plot after sowing and treatment application in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) with 102.5 seeds/ plant & 1525 seeds/ plot and was found statistically at par with treatment T8 (0.5% *Ascophyllum nodosum* solution) with 93.07 seeds/ plant & 1393 seeds/ plot whereas, in desi chickpea genotypes the application of treatment T3 (2% *Ascophyllum nodosum* solution) recorded highest number of seeds with 100.4 seeds/ plant & 1425 seeds/ plot and was found statistically at par with treatment T2 (1.0% *Ascophyllum nodosum* solution) with 84.4 seeds/ plant & 1410 seeds/ plot.

The maximum seed yield per plant and per plot after sowing and treatment application in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) 28.30 gm/ & 358.44 gm/ plot plant and was found statistically at par with treatment T9 (1.0% *Ascophyllum nodosum* solution) with 26.78

gm/ & 333.18 gm/ plot plant whereas, in desi chickpea genotypes the application of treatment T3 (2% *Ascophyllum nodosum* solution) recorded highest seed yield per plant & per plot with 25.35 gm/ plant & 328.86 gm/ plot and was found statistically at par with treatment T2 (1.0% *Ascophyllum nodosum* solution) 23.82 gm/ plant & 319.59 gm/ plot.

The maximum biological & yield per hector after sowing and treatment application in kabuli genotype was recorded in treatment T10 (2.0% *Ascophyllum nodosum* solution) with 3187.42 & 1341.67 kg/ ha and was found statistically at par with treatment T9 (1.0% *Ascophyllum nodosum* solution) with 3092.49 & 1252.00 kg/ ha whereas, in desi chickpea genotypes the application of treatment T3 (2% *Ascophyllum nodosum* solution) recorded highest biological yield per hector with 3061.24 & 1231.33 /kg and was found statistically at par with treatment T2 (1.0% *Ascophyllum nodosum* solution) 2987.73 & 1217.00/kg.

The maximum harvest index after sowing and treatment application in kabuli genotype was recorded in treatment T7 (Untreated check) i.e., 44.08 and was followed by treatment T12 (1.0% red and brown algae solution) and T13 (2.0% red and brown algae solution) with 42.63 and 42.43 respectively whereas, in desi chickpea genotype, the application of treatment T0 (Untreated check) recorded the highest harvest index i.e., 43.67 and was followed by treatment T1 (0.5% *Ascophyllum nodosum* solution) and T5 (1.0% red and brown algae solution) with 42.39 and 41.94 respectively.

TABLE 1 : Effect of seaweed extracts on different growth parameters:

Tr. No.		Percent Field Emergence			Days to 50% flowering	Days to maturity	Plant height		Number of branches	
		4 DAS	7 DAS	10 DAS			25 DAS	50 DAS	25 DAS	50 DAS
T0	Desi Chickpea Control (Untreated)	6.30	35.19	50.74	82.67	136.33	7.60	12.97	1.20	1.93
T1	Desi seeds treated with 0.5% *Ascophyllum nodosum* solution	9.26	41.48	60.00	86.67	142.33	10.67	23.50	1.67	3.73
T2	Desi seeds treated with 1.0% *Ascophyllum nodosum* solution	8.52	42.59	70.37	87.00	147.67	13.87	26.60	3.27	5.60
T3	Desi seeds treated with 2.0% *Ascophyllum nodosum* solution	10.74	47.41	70.74	86.00	154.00	16.60	33.57	3.93	7.00
T4	Desi seeds treated with 0.5% red and brown algae solution	9.26	40.74	61.11	83.00	148.00	10.87	21.60	2.00	4.60
T5	Desi seeds treated with 1.0% red and brown algae solution	8.89	33.33	65.93	84.67	147.33	10.87	18.87	1.13	3.87
T6	Desi seeds treated with 2.0% red and brown algae solution	8.15	40.37	55.56	85.33	140.67	11.00	21.80	1.53	4.13
T7	Kabuli Chickpea Control (Untreated)	7.04	39.63	57.41	81.67	138.00	8.67	17.00	1.00	3.53
T8	kabuli seeds treated with 0.5% *Ascophyllum nodosum* solution	9.26	43.33	70.00	85.00	149.00	13.53	27.97	1.87	6.73
T9	kabuli seeds treated with 1.0% *Ascophyllum nodosum* solution	10.37	44.44	72.22	84.33	151.67	16.87	34.73	4.07	6.80
T10	kabuli seeds treated with 2.0% *Ascophyllum nodosum* solution	10.74	49.26	77.41	88.67	156.33	17.93	36.70	4.47	7.27
T11	kabuli seeds treated with 0.5% red and brown algae solution	7.78	39.26	63.70	82.33	143.33	11.47	26.20	2.13	4.33
T12	kabuli seeds treated with 1.0% red and brown algae solution	8.15	44.07	65.19	83.67	147.33	13.40	24.67	1.53	4.13
T13	kabuli seeds treated with 2.0% red and brown algae solution	9.63	44.81	61.11	85.33	141.00	12.73	25.33	2.13	3.80
	SE(m) ±	**0.69**	**2.29**	**4.36**	**-**	**3.71**	**0.84**	**1.90**	**0.20**	**0.40**
	CD at 5%	**2.01**	**6.67**	**12.66**	**-**	**10.78**	**2.45**	**5.51**	**0.57**	**1.17**
	CV %	**13.52**	**9.50**	**11.71**	**-**	**4.40**	**11.60**	**13.08**	**14.95**	**14.52**

TABLE 2 : Effect of seaweed extracts on different yield parameters:

Tr. No.		Number of pods per plant	Number of pods per plot	Seed yield gm plant^{-1}	Seed yield gm plot^{-1}	Number of seeds per plant	Number of seeds per plot	Biological yield (Kg ha^{-1})	Economical yield (Kg ha^{-1})	Harvest index
T0	Desi Chickpea Control (Untreated)	41.56	626.67	16.42	272.70	69.3	1044	2313.05	1010.00	43.67
T1	Desi seeds treated with 0.5% *Ascophyllum nodosum* solution	49.68	769.67	22.41	316.35	82.8	1282	2716.33	1151.33	42.39
T2	Desi seeds treated with 1.0% *Ascophyllum nodosum* solution	57.31	901.33	23.82	319.59	84.4	1410	2987.73	1217.00	40.73
T3	Desi seeds treated with 2.0% *Ascophyllum nodosum* solution	60.24	922.00	25.35	328.86	100.4	1425	3061.24	1231.33	40.22
T4	Desi seeds treated with 0.5% red and brown algae solution	50.44	767.67	20.84	305.37	84.1	1278	2837.07	1171.67	41.30
T5	Desi seeds treated with 1.0% red and brown algae solution	48.68	768.33	20.58	310.86	81.1	1279	2648.16	1110.67	41.94
T6	Desi seeds treated with 2.0% red and brown algae solution	51.32	784.67	19.89	300.01	85.5	1307	2847.74	1152.00	40.45
T7	Kabuli Chickpea Control (Untreated)	44.68	817.67	17.56	291.15	74.5	1167	2446.55	1078.33	44.08
T8	kabuli seeds treated with 0.5% *Ascophyllum nodosum* solution	55.91	976.00	22.54	311.04	82.1	1393	3004.98	1207.00	40.17
T9	kabuli seeds treated with 1.0% *Ascophyllum nodosum* solution	56.20	860.33	26.78	333.18	93.7	1228	3092.49	1252.00	40.49
T10	kabuli seeds treated with 2.0% *Ascophyllum nodosum* solution	61.52	1025.67	28.30	358.44	102.5	1525	3187.42	1341.67	42.09
T11	kabuli seeds treated with 0.5% red and brown algae solution	52.28	929.33	21.78	325.89	87.1	1327	2888.33	1183.67	40.98
T12	kabuli seeds treated with 1.0% red and brown algae solution	51.97	955.67	21.06	329.04	86.4	1317	2653.20	1131.00	42.63
T13	kabuli seeds treated with 2.0% red and brown algae solution	54.16	874.00	19.41	328.59	90.3	1248	2896.00	1228.67	42.43
	SE(m) ±	**3.09**	**36.49**	**1.27**	**12.01**	**3.51**	**48..41**	**101.99**	**41.71**	-
	CD at 5%	**8.99**	**106.07**	**3.70**	**34.9**	**10.19**	**140.72**	**144.23**	**121.24**	-
	CV %	**10.20**	**7.39**	**10.06**	**6.57**	**7.06**	**6.44**	**6.25**	**6.14**	-

TABLE 3 : Analysis of variance for quantitative characters in chickpea.

S.No.	Characters	Mean sum of square		
		Replications (df=2)	Treatments (df=13)	Error (df=26)
1.	Percent Field Emergence at 4 DAS	46.77	5.22*	37.33
2.	Percent Field Emergence at 7 DAS	918.90	55.65*	15.80
3.	Percent Field Emergence at10DAS	160.54	1673.48*	56.89
4.	Days to maturity	1152.93	104.68*	41.24
5.	Plant height at 25 DAS	12.41	27.65*	55.73
6.	Plant height at 50 DAS	1.20	135.77*	10.78
7.	No. of branches at 25 DAS	2.56	4.06*	0.12
8.	No. of branches at 50 DAS	11.56	7.68*	0.49
9.	No. of pods per plant	277.40	92.74*	28.72
10.	No. of pods per plot	6195.07	34002.33*	3994.43
11.	Seed yield per plot	9.43	33.18*	4.86
12.	No. of seed per plant	995.13	237.25*	36.89
13.	No. of seeds per plot	19016.74	41627.27*	7029.92
14.	Biological yield	61204.50	185800.68*	31204.64
15.	Economical yield	14229.74	19926.65*	5218.15

* Significant at 5% level of significance.

CONCLUSION:

Among the different seaweed extracts used during the experiment the most superior values are recorded from the treatment with 2% *Ascophyllum nodosum* solution in both kabuli as well as desi chickpea genotype. An agronomical parameters such as field germination percentage, days to 50% flowering, days to maturity, plant height and number of branches was recorded maximum in treatment with 2.0% *Ascophyllum nodosum.* Similarly, the same treatment with 2% *Ascophyllum nodosum* recorded maximum numbers of pods per plant & number pods per plot, number seeds per plant & number seeds per plot and yield per plant & yield per plot. Yield parameters such as biological yield per hector, economical yield per hector and harvesting index were recorded, and they gave the highest values in treatment 2.0% *Ascophyllum nodosum* and were found at par with treatment 1.0% *Ascophyllum nodosum* followed by treatment 0.5% *Ascophyllum nodosum.* The remaining treatment 2.0% red and brown algae, 1.0% red and brown algae and 0.5% red brown algae recorded the second best treatment. The maximum growth and yield parameters can be achieved through the treatment with 2.0% *Ascophyllum nodosum* solution in both kabuli as well as desi chickpea genotype.

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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.

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