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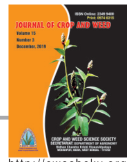

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Influence of botanicals and chemical seed treatments on growth and yield attributing traits of Quinoa (*Chenopodium quinoa* Willd). cv. EC 507742

***G. SNEHA, A. DAYAL, P. K. RAI AND G. GHOSH**

Department of Genetics and Plant Breeding, Naini Agricultural Institute,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, 211007 ,U. P., India.

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ABSTRACT

Field experiment was held at Cental Research Field of Department of Genetics and Plant Breeding, SHUATS, Prayagraj, Uttar Pradesh during rabi season, 2020-2021, in order to find out the suitable seed treatments of quinoa (variety EC 507742). The results showed that neem leaf extract3% (3hrs) primed seeds recorded highest field emergence percentage, plant height at 60 and 90DAS, number of branches plant^{-1}, number of panicles plant^{-1}, number of productive panicles plant^{-1}, days to 50% flowering, days to maturity, seed yield plant^{-1}(g), seed yield plot^{-1}(g), biological yield, harvest index compared to other treatments. Neem leaf extract was found easily bio-degradable, non-toxic, environmentally safe and easily accessible for farmers to apply at their own field and is suitable for organic farming.

***Keywords*:** $CaCl_2$, KCl, neem leaf extract, quinoa, yielding attributes.

One of the world's most popular healthy foods recognized all around the world is Quinoa (*Chenopodium quinoa* Willd), a gynomonoecious plant belongs to the family Amaranthaceae (former Chenopodiaceae) with number of chromosomes (2n = 4x = 36). It is an allotetraploid crop with drought tolerance, rich in antioxidant content and increasing in the worldwide market (Risi and Galwey, 1984). Furthermore, quinoa can be securely utilised for consumption because of absence of protein known as gluten (Wu *et al.,* 2016). The year 2013 was declared as International year of Quinoa by FAO.

About 70 countries made quinoa as a part of agricultural practices. Quinoa is predominantly self-pollinating species, but pollination inside the inflorescence by means of wind (anemophilous) or with support of small insects (entomophilous) occurs.

It is an age old crop from the Andes mountains of South America that has gained substantial global wide popularity for its health benefits, nutritional factors that could improve metabolic health (Vega-Galvez *et al*., 2010). Quinoa has high anti-inflammatory properties, aids in prevention and treatment of disease. It is a well balanced supplement of enough quantities of important amino acids like methionine, histidine, isoleucine and also a pretty good source of fibre, iron and mineral (Vilcacundo and Hernández, 2017).

Quinoa is a halophyte, with excessive salinity tolerance, it is recommended to poor and barren lands by FAO. In recent years, there has been increasing recognition of the importance of quinoa as a substitute for major cereal crops.It was neglected in the past years due to its bitterness which was caused by saponin, now it's gaining popularity thanks to its many health benefits. (Isobe *et al*., 2014).

Inspite of its extensive adaptability, dietary superiority and rusticity its industrial capacity has remained untapped. In India, an outsized part of the populace has little access to protein-rich diet, protein content is more in quinoa accessions has been reported to range from 12 to 17%, counting on variety, environment and inputs. Quinoa's surprisingly proteinaceous grain is an excellent source for vegetarians and vegans, can assist to make diets extra balanced and can play an important function in combating 'silent hunger' amongst tribal populations in India who've little access to protein-rich diet (Bhargava *et al.,* 2006).

In botanical priming specific botanical extracts like moringa leaf extract, neem leaf extract are used for seed priming. Plant extracts had been acknowledged for their medicinal and antimicrobial properties from historic times. Natural chemical compounds from plants are cheap, readily available and cost effective in growing nations where synthetic fungicides are scarce and high priced for poverty- stricken farmers (Gurjar *et al.,* 2012).

The experiment was carried out at Cental Research Field at Department of Genetics and Plant Breeding, SHUATS, U.P during *rabi* season, 2020-2021 on the variety EC 507742 to study the effect of various seed treatment techniques on quinoa and also find out best seed treatment for it. Field experiment was laid out in randomised block design (RBD) with three replications. The treated seeds were sown on 24th October 2020.

Short Communication

Email: snehagandla.98@gmail.com

For the preparation of 3% and 5% solution of neem oil, 3ml and 5ml of neem oil was taken in a beaker with 3ml of liquid soap (Emulsifier) added in 100ml of pure water with continous agitation. The final volume was made to one litre, and then it was turned into3% and 5% solution of neemoil (Nicoletti *et al.,* 2012).

The tender leaves of the respective plants were collected separately and dried beneath the shade. The dried leaves were ground with electric mixer- grinder or mortar and pestle. The extract was subjected to sieving repeatedly through muslin cloth and then exactly 30 grams and 50 grams of leaf powder was taken using weighing balance and diluted with 100ml of pure water to prepare the required 3% and 5% leaf extract solutions for seed priming (Gurjar *et al.,* 2012).

For the preparation of 3% solution of saturated salt, 30 grams and 50 grams of $CaCl_2$, KCl and NaCl was taken in different beakers. Treatments were added in 100ml of pure water with continous agitation. The final volume was made to one litre, and then it was turned into 3% and 5% solutions of $CaCl_2$, KCl and NaCl chemicals.

Since the study was conducted to evaluate and standardize the pre sowing treatments for quinoa, results reported that there was completely significant difference between treated and untreated seeds.

The maximum field emergence (90%) was recorded inT_3– neem leaf extract 3% followed by T_8– $CaCl_2$ 5% (89%) whereas minimum field percentage was recorded in control (78.67%). The similar findings reported that when the groundnut seeds were treated with neem leaf extract 5%, an active chemical substance azadirachtin gave protection against insect and pathogens. It is significantly higher in terms of field emergence, plant height, days to 50% flowering, days to maturity and yield attributes (Sanoj Kumar *et al.*, 2017).

The maximum plant height at 60DAS (107.63cm) was recorded inT_3– neem leaf extract 3% followed by T_8– $CaCl_2$ 5% (105.63cm) whereas minimum plant height at 60DAS was recorded in control (84.13cm) Gayathri and Gopal (2018) found that quinoa seeds primed with $CaCl_2$ was recorded higher in plant height (78.01), when compared to other treatments due to proteins and free amino acids soluble sugars.

The maximum plant height at 90DAS (132.50cm) was recorded in T_3– neem leaf extract 3% followed by T_8– $CaCl_2$ 5% (129.77cm) whereas minimum plant height at 90 DAS was recorded in control (101.13cm) Chavan *et al.* (2014) concluded that several studies have indicated that the plant height can be increased or decreased by different seed primings. The significant effect was observed in seeds treated with $CaCl_2$ that might be due to the role of calcium in membrane integrity and enzyme cofactor and beneficial effect of exogenous application of GA3 increases hypocotyls length and positively increases in plant height.

The maximum number of branches per plant (18.53) was recorded in T_3– neem leaf extract 3% followed by T_8– $CaCl_2$ 5% (17.80) whereas minimum number of branches per plant was recorded in control (10.13) Deepak *et al.* (2020) found that the primed seeds of lentil with neem leaf extract which contains flavonoids, steroids, terpenoids producing antioxidant activity are significantly higher in terms of germination percentage, number of branches per plant, seeds per pod, yield per plant and yield per ha.

The maximum seed yield per plant (90.92) was recorded in T_3– neem leaf extract 3% followed by T_8–

Table 1: Analysis of variance for different characters in Quinoa (*Chenopodium quinoa*Willd)

S. No	Characters	Mean sum of square		
		Replications (df=2)	Treatments (df=12)	Error (df=24)
1	Field Emergence per cent	1.26	30.66*	4.01
2	Plant Height (cm) at 60 DAS	0.50	109.50*	13.15
3	Plant Height (cm) at 90 DAS	10.20	204.82*	31.53
4	No. Branches Per Plant	0.42	19.98*	2.09
5	Total No. of Panicles plant^{-1}	1.37	15.98*	0.22
6	Total No. of ProductivePanicles Plant^{-1}	0.01	7.10*	0.34
7	Days to 50% Flowering	1.25	6.07*	0.75
8	Days to Maturity	0.48	7.08*	0.43
9	Seed Yield Plant^{-1}	10.67	168.09*	0.80
10	Seed Yield Plot^{-1}	26.05	19256.15*	256.39
11	Biological Yield	0.17	50.27*	1.46
12	Harvest Index	10.82	9397.12*	702.25

*Significant at both 5% and 1% level, respectively

Table 2: Mean performance of different treatments for growth and yielding attributes in Quinoa (*Chenopodium quinoa* Willd).

Treatments emergence	Field 60 DAS %	Plant height at 90 DAS (cm)	Plant height at branches (cm)	Number of of panicles per plant	Total number productive plant^{-1}	Total number of flowering panicles plant^{-1}	Days to 50% maturity	Days to
T_0- Control	78.67	84.13	101.13	10.13	6.53	5.13	70.00	120 .00
T_1- Neem oil 3%	85.00	92.93	116.03	12.80	9.13	7.80	67.33	117.00
T_2- Neem oil 5%	82.67	93.78	112.33	12.06	8.93	7.07	68.33	116.00
T_3- Neem leaf extract 3%	90.00	107.63	132.50	18.53	13.40	10.13	65.00	114.33
T_4-Neem leaf extract 5%	80.33	91.30	107.16	10.73	6.80	5.53	69.67	118.67
T_5-Moringa leaf extract 3%	81.67	94.50	120.83	14.67	7.30	6.33	67.00	116.67
T_6-Moringa leaf extract 5%	82.33	96.87	116.83	14.40	11.60	5.53	67.67	117.00
T_7-$CaCl_2$ 3%	83.33	95.83	113.00	15.47	10.60	6.26	67.00	115.00
T_8-$CaCl_2$ 5%	89.00	105.63	129.77	17.80	12.93	9.93	65.67	115.33
T_9-KCl 3%	81.00	91.63	114.50	14.00	7.40	7.40	67.33	117.00
T_{10}-KCl 5%	82.00	93.73	119.33	11.20	8.20	7.60	66.00	118.00
T_{11}-NaCl 3%	84.33	95.67	115.10	13.93	7.26	7.00	68.00	116.00
T_{12}-NaCl 5%	83.00	91.83	115.33	11.73	9.66	7.73	67.67	117.33
Grand Mean	**83.33**	**95.03**	**116.45**	**13.65**	**9.21**	**7.18**	**67.43**	**116.79**
C.V.	**2.40**	**3.81**	**4.82**	**10.60**	**5.14**	**8.17**	**1.29**	**0.56**
S.E.	**1.15**	**2.09**	**3.24**	**0.83**	**0.27**	**0.33**	**0.50**	**0.38**
C.D. 5%	**3.37**	**6.11**	**9.46**	**2.44**	**0.80**	**0.99**	**1.46**	**1.10**
C.D. 1%	**4.57**	**8.28**	**12.82**	**3.30**	**1.08**	**1.34**	**1.98**	**1.50**

Table 3: Mean performance of different treatments for growth and yielding attributes in Quinoa (*Chenopodium quinoa* Willd).

Treatments	**Seed yield plant^{-1} (g)**	**Seed yield plot^{-1} (g)**	**Biological yield (g)**	**Harvest index**
T_0- Control	66.70	520.05	1191.52	43.64
T_1- Neem oil 3 T_0%	73.90	608.45	1248.61	48.69
T_2- Neem oil 5%	78.13	715.00	1312.89	54.45
T_3- Neem leaf extract 3%	90.92	761.31	1350.08	56.38
T_4-Neem leaf extract 5%	68.07	542.14	1200.31	45.74
T_5-Moringa leaf extract 3%	81.27	745.26	1339.96	55.61
T_6-Moringa leaf extract 5%	81.27	658.68	1250.80	52.67
T_7-$CaCl_2$ 3%	85.70	728.01	1338.90	54.37
T_8-$CaCl_2$ 5%	89.20	750.80	1338.98	56.07
T_9-KCl 3%	74.80	610.77	1256.57	48.67
T_{10}-KCl 5%	77.07	603.07	1236.94	48.76
T_{11}-NaCl 3%	85.63	669.30	1312.42	51.00
T_{12}-NaCl 5%	82.67	702.50	1323.23	53.08
Grand Mean	**79.64**	**662.71**	**1284.71**	**51.47**
C.V.	**1.12**	**2.41**	**2.06**	**2.34**
S.E.	**0.51**	**9.24**	**15.30**	**0.69**
C.D. 5%	**1.51**	**26.98**	**44.65**	**2.03**
C.D.1%	**2.05**	**36.56**	**60.51**	**2.76**

$CaCl_2$ 5% (89.20) whereas minimum seed yield per plant was recorded in control (66.70). Bethala *et al.* (2018) found that seeds primed with $CaCl_2$ increases the activity in metabolic process and are significantly higher in yield and yield attributing characters.

The maximum seed yield per plot (761.31) was recorded in T_3– neem leaf extract 3% followed by T_8– $CaCl_2$ 5% (750.80) whereas minimum seed yield per plot was recorded in control (520.05). The maximum biological yield (1350.08) was recorded in T_3– neem leaf extract 3% followed by T_5– moringa leaf extract 3% (1339.96) whereas minimum biological yield was recorded in control (1191.52) Mahboob *et al.* (2015) found that seed treatments increased the grain yield, biological yield and harvesting index over unprimed seeds. However, biological yield was recorded highest when primed with $CaCl_2$. Seed priming with $CaCl_2$ increases the vital role of Ca to enhance crop resistance against abiotic stresses. The maximum harvest index (56.38%) was recorded in T_3– neem leaf extract 3% followed by T_8– $CaCl_2$ 5% (56.07%) whereas minimum harvest index was recorded in control (43.64%).

In the investigation, it was noticed that pre sowing treatments have shown significantly better performance than control. Among the pre sowing seed treatment, seeds treated with neem leaf extract 3%(T_3) have shown superior performance followed by $CaCl_2$ 5%(T_8) in all the yield attributing traits. It is concluded that botanically treated seeds are productively higher in terms of seed yield per plant and seed yield per plot. Therefore further study is needed to arrive at valid recommendations.

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