The Pharma Innovation Journal 2021; 10(8): 1883-1887

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(8): 1883-1887

www.thepharmajournal.com
Received: 16-06-2021
Accepted: 20-07-2021

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Effect of seed enhancement treatments on seed vigour potential and field parameters of wheat seed produced under zero tillage condition

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Abstract
Wheat (*Triticum aestivum* L.) is a widely adapted crop. It is grown from temperate, irrigated to dry and high-rain-fall areas and from warm, humid to dry, cold environments. Seed produced under zero tillage condition leads to moisture stress in the field condition which might affect the vigour potential of seed. Generally stress (moisture) has deleterious effect on germination and vigour of crop.In the present investigation, the single lot of wheat variety DBW 14 was sown under two different tillage conditions after treatments with different seed enhancement agents with the objective to assess their effect on seed vigour potential. Seed vigour potential of seed lot produced under zero tillage was comparatively inferior to that of normal tillage. Treatment with KNO_3 (2%) significantly improved followed by combined treatment of KNO_3 (2%) and Bavistin, (2g/kg of seed) of all the seed vigour potential parameters *viz.*, 100 seed weight, standard germination, seedling dry weight, seedling length, vigour index-I and vigour index-II, mean emergence time and field emergence index show lower value in zero tillage condition in comparison to normal tillage.
In field parameters seed yield and its component traits of seed lot produced under zero tillage was comparatively inferior to that of normal tillage. Treatment with $CaCl_2$ (2%) followed by Bavistin (T_7, 2 gram per kg of seed) significantly improved followed by combined treatment of hydration with distilled water followed by Bavistin (T_6, 2 gram per kg of seed) of all the seed yield component parameters *viz.*, plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant which was lower value in zero tillage condition than in normal tillage.

Keywords: wheat, seed, enhancement, tillage, vigour, field parameters

Introduction
Wheat is a one of the most important cereal crop in India. India is the second largest producer of wheat in the world after China. The area, production and productivity of wheat in India is about 30.27 Mha, 93.50 MT and 0.309 MT/ha respectively (Anonymous, 2015-16) [7]. Seed is a basic and vital input for sustained growth in agricultural productivity and production since ninety percent of the food crops are grown from seed (Schwinn 1994) [23]. Good quality seed can increase yields by 5-20 percent. The extent of this increase is directly proportional to the quality of seed that is being sown. Wheat yields in the South Asia where rice-wheat cropping system being followed are suffering due to delayed sowing, late harvesting of rice, short period of winter seasons, less developed facilities of irrigation and poor crop stands due to lack of optimal moisture.
There is not much study available whose directly reflect the status of seed quality being grown under zero tillage and its improvement through seed enhancement treatment. Several workers have already reported that seed enhancement treatment with certain agent is improving the seed quality parameters. Harris (1996) [13] demonstrated that simply soaking seeds in plain water before sowing could increase the speed and uniformity of germination and emergence, leading to better crop stands, and stimulated seedlings to grow much more vigorously. In pre sowing seed enhancement treatment, seeds are soaked in different solutions with high osmotic potential due to prevent the seeds from absorbing enough water for radical protrusion, which is suspending the seeds in lag phase (Taylor *et al.* 1998) [26]. Pre sowing seed enhancement treatment as been commonly used to reduce the time between seed sowing and seedling emergence and to synchronize emergence (Parera and Canliffe, 1994) [19].
The study entitled was carried out at Bihar Agricultural University, Sabour, Bhagalpur (Bihar) in rabi 2016-17.

Single seed lot of DBW 14 was treated with different seed enhancement treatment *viz*., KNO_3 (T_1, 2.0%, 18h), Hydration-Dehydration (T_2, H-D, 8h), $CaCl_2$ (T_3, 2.0%, 12h), seed dressing with Bavistin (T_4, 2 gram per kg of seed), hydration with KNO_3 (2.0%) followed by Bavistin (T_5, 2 gram per kg of seed),hydration with distilled water followed by Bavistin (T_6, 2 gram per kg of seed), hydration with $CaCl_2$(2%) followed by Bavistin (T_7, 2 gram per kg of seed).Seed enhancement treatment was done by soaking of required quantity of seeds in tap water with different chemicals for different hours in ratio of 1:2 (Kg of seeds/volume of solution) by using wet gunny bag. Then the treated or primed seeds were dried in shade to maintain the seed moisture content approximately 12 or 13%.Treated seeds were sown in the plot size area of 7x4 square meters with a spacing of 20x10 cm. Seed lots were adjusted in six number of plot. Treated seeds along with control (untreated) were sown in two separate experiments for normal and zero tillage conditions and crop was raised with recommended package and practices. Processed seeds were examined for the quality parameters and data were recorded on 100 seed weight (g), germination (%), seedling dry weight (mg), seedling length (cm), [seedling vigour index-I (Germination × seedling length), seedling vigour index-II (Germination × Seedling dry weight), Abdul-Baki and Anderson, (1973)] [2], mean emergence time, MET, [Ellis and Roberts (1980)] [8] and field emergence index, [FEI, Maguire (1962)] [16] for the field parameters and data were recorded on plant height (cm), seed yield per plant (SYP, g), seed yield per square meter (SYM, g) number of spike per square meter (NSP), number of seeds per spike (NSS) and harvest index per plant (HIP).

Results and Discussion

The seed enhancement treatments have already been proven to improve germination and vigor potential of seed lot in several crops that contributes to the better crop establishment in field. The seed yield is a complex character and dependant on many attributes. The high vigorous seed gives better plant growth which lead to higher seed yield per unit area. The seed enhancement treatments had enhanced all seed quality parameters under both the tillage condition and field parameters in present study.

Table 1: Mean values for different laboratory parameters under normal tillage conditions:

	100 Seed weight (g)	Standard Germination (%)	Seedling Length (cm)	Seed Dry Weight (mg)	Vigour Index-I	Vigour Index-II	Mean Emergence Time	Field Emergence Index
Normal Tillage(B1)	3.42	95.54	19.30	41.41	1844.72	3939.27	5.34	82.09
Zero Tillage (B2)	3.36	94.21	17.90	39.53	1687.23	3725.98	5.55	80.28
CD (0.01)	0.049	1.200	0.295	0.571	39.215	72.938	0.275	1.284

Effect of tillage condition

The 100 seed weight, germination (%), seeding length, seedling dry weight, vigour index-I, vigour index-II, mean emergence time and field emergence index was recorded significantly higher in seed lot harvested from normal tillage (3.42, 95.54, 19.30, 41.41, 1844.72, 3939.27, 5.34, 82.09 respectively) than in zero tillage (3.36, 94.21, 17.90, 39.53, 1687.23, 3725.98, 5.55, 80.28 respectively). The percent increment over and above zero tillage condition for 100 seed weight, germination (%), seeding length, seedling dry weight, vigour index-I, vigour index-II, mean emergence time and field emergence index was 1.78, 1.41, 7.25, 4.75, 9.33, 5.72, 3.78, 2.25 respectively (table 1).

Table 2: Mean values for different laboratory parameters under normal tillage conditions:

Tillage Conditions	PH	SYP	SYM	NSP	NSS	HIP
Normal Tillage (B1)	74.64	1.58	583.96	369.13	46.75	39.43
Zero Tillage (B2)	71.33	1.51	544.46	360.58	44.24	36.85
CD (0.01)	NS	0.072	27.667	10.807	2.267	1.835

PH: Plant height: SYP: seed yield per plant; SYM: seed yield per square meter; NSP: number of spike per square meter; NSS: number of seeds per spike; HIP: and harvest index per plant

Effect of tillage condition

The plant height (cm), seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant was recorded significantly higher from normal tillage (74.64, 1.58, 583.96, 369.13, 46.75, 39.43 respectively) than in zero tillage (71.33, 1.51, 544.46, 360.58, 44.24, 36.85 respectively). The percent increment over and above for zero tillage condition plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant was 4.43, 4.43, 6.76, 2.31, 5.36 and 7.22 respectively (table 2).

Table 3: Mean values for seed vigour parameters under different tillage conditions

Treatments	100 Seed weight (g)	Standard Germination (%)	Seedling Length (cm)	Seed Dry Weight (mg)	Vigour Index-I	Vigour Index-II	Mean Emergence Time	Field Emergence Index
Normal Tillage (B_1)								
B_1T_0	3.18	92.67	18.10	41.4	1677.40	3718.77	6.18	77.03
B_1T_1	3.56	98.00	20.73	42.4	2032.00	4272.20	4.36	88.14
B_1T_2	3.42	94.33	18.45	41.6	1740.64	3847.93	5.42	86.15
B_1T_3	3.43	94.33	19.67	39.6	1854.20	3741.87	5.52	77.37
B_1T_4	3.34	96.67	19.19	39.2	1855.56	3847.83	5.24	82.07
B_1T_5	3.57	96.50	19.57	43.6	1888.35	4200.07	5.21	82.73
B_1T_6	3.42	95.83	19.09	41.4	1829.61	3943.13	5.63	78.61
B_1T_7	3.46	96.00	19.58	40.4	1880.02	3942.33	5.16	84.62

Zero Tillage (B_2)								
B_2T_0	3.15	90.35	16.92	37.67	1528.85	3402.60	6.34	76.03
B_2T_1	3.43	97.00	18.63	41.47	1806.86	4022.60	5.35	86.44
B_2T_2	3.33	93.67	17.81	39.93	1668.04	3739.73	5.61	79.22
B_2T_3	3.38	93.33	17.89	38.80	1669.92	3621.87	5.39	77.73
B_2T_4	3.36	93.50	17.61	39.30	1647.30	3675.40	5.82	82.03
B_2T_5	3.45	96.00	18.40	40.20	1765.78	3860.60	5.55	76.07
B_2T_6	3.36	95.50	17.82	39.87	1702.75	3805.77	5.37	79.18
B_2T_7	3.39	94.33	18.11	39.00	1708.31	3679.30	5.49	85.55
CD (0.01)	0.077	NS	0.661	1.404	112.991	224.824	0.777	3.632

Effect of seed enhancement treatments

Normal tillage

All the pre-sowing seed enhancement treatment were found significantly improve the seed quality in terms of 100 seed weight, seed germination, seedling length, seedling dry weight, seed vigour index-I, seed vigour index-II, mean emergence time and field emergence index of wheat when was raised under normal tillage condition (table 2). Similar findings were also reported gby Kathiresan *et al.* (1984, sunflower) [15], Farooq *et al.* (2006, rice) [9], Afzal *et al.* (2007, wheat) [4], Abbasdokht *et al*. (2010, wheat) [1], Hanegave *et al.* (2011, maize) [12] and Singh *et al.* (2017, wheat) [25].

Treatment with KNO_3 results in highest percent improvement over control for 100 seed weight, germination, seedling length, seedling dry weight, seed vigour index-I, seed vigour index-II, field emergence index and mean emergence time showed percent improvement 11.95, 5.76, 14.55, 8.65, 21.14, 14.88, 14.42 and reduction of 29.45 with values of 3.56g, 98.00 percent, 18.10cm, 43.60mg, 2030.00, 4272.20, 88.14 and 4.36days, respectively. Similar results were also found by Ahmadvand *et al.* (2012) [6], Ghobadi *et al.* (2012) [11] and Singh *et al.* (2017) [25] in wheat, Ajirloo *et al*. (2013) in maize.

Next best treatment was KNO_3 (2.0%) followed by seed dressing with bavistin which showed significantly better performance & at par to KNO_3 for improving the 100 seed weight, germination, seedling length, seedling dry weight, seed vigour index-I, seed vigour index-II, field emergence index and mean emergence time showed percent improvement of 12.26, 4.14, 19.57, 8.47, 12.58, 6.03, 15.70 and reduction of 7.40with values of 3.57g, 96.50 percent, 19.57cm, 43.53g, 1888.35, 4200.07, 82.73 and 5.21 days respectively over untreated seeds. These findings were strongly supported by Farooq *et al.* (2008) [10] Ghobadi *et al.* (2011) [11], Toklu *et al.* (2015) [27] in wheat, Derya Ozveren Yucel *et al.* (2012) [28] in lentil, Adinde *et al.* (2016) [3] in green pepper, Patel *et al.* (2017) [20] in brinjal & tomato.

Zero tillage

In the present study when wheat crop sown under zero tillage after treatment of seed with different pre-sowing seed enhancement treatments, it results in improvement of seed quality in terms of 100 seed weight, seed germination, seedling length, seedling dry weight, seed vigour index-I, seed vigour index-II, mean emergence time and field emergence index (table 2).Poor crop establishment is a major problem in wheat production under zero tillage condition.

Seed treatments with KNO_3 significantly improved the all the seed quality parameters with percentage increment of 8.89, 7.36, 10.09, 10.09, 18.18, 18.22, 13.69 and reduction of 12.62 in 100-seed weight, seed germination, seedling length, seedling dry weight, seed vigour index-I, seed vigour index-II, field emergence index and mean emergence time, respectively over control with values of 3.43 g, 97 percent, 18.63 cm, 41.47 mg, 1806.86, 4022.60, 5.35 days and 86.44 respectively.

Next to KNO_3,treatment with KNO_3 (2.0%) followed by seed dressing with bavistin given better result which exhibited statistically at par to KNO_3 for 100-seed weight, seed germination, seedling length, seedling dry weight, seed vigour index-I, seed vigour index-II, field emergence index and mean emergence time with percentage increment of 9.52, 6.25, 8.73, 6.72, 15.50, 13.46, 0.05 and reduction of 12.46 over untreated seeds with value of 3.45 g, 96.00 percent, 17.82 cm, 39.87 mg, 1702.75, 3805.77, 79.18 and 5.37 days, respectively.

It was very much clear from the findings of experiment that untreated seeds exhibited significantly inferior performance. Seed treated with KNO_3(2.0%) exhibited better quality which is followed by $CaCl_2$ (2%), $CaCl_2$ (2%) followed by seed dressing with bavistin, distilled water, seed dressing with bavistin, distilled water followed by seed dressing with bavistin, $CaCl_2$ (2%) followed by seed dressing with bavistin that scored nearly similar values and were at par to control that exhibited germination (%), seedling length (cm), seedling dry weight (g), seed vigour index-I, seed vigour index-II, mean emergence time and field emergence index respectively.

Table 4: Mean values for field parameters under different tillage conditions

Treatments	PH	SYP	SYM	NSP	NSS	HIP
Normal Tillage (B_1)						
B_1T_0	74.29	1.45	500.43	344.33	43.93	35.80
B_1T_1	75.45	1.61	638.70	395.67	47.13	40.39
B_1T_2	74.34	1.52	603.79	396.33	44.63	37.21
B_1T_3	74.40	1.54	535.13	348.67	45.17	38.40
B_1T_4	73.20	1.53	566.12	369.67	46.50	38.36
B_1T_5	74.43	1.54	572.51	372.33	44.77	38.65
B_1T_6	75.40	1.66	572.23	345.17	49.33	41.59
B_1T_7	75.62	1.79	682.75	380.83	52.53	45.03
Zero Tillage (B_2)						
B_2T_0	70.62	1.41	483.60	342.17	39.93	34.08
B_2T_1	70.29	1.49	577.75	389.00	43.60	35.98
B_2T_2	71.21	1.44	511.74	356.50	42.50	34.96
B_2T_3	71.04	1.57	540.85	343.50	46.50	38.18
B_2T_4	71.67	1.46	527.73	369.17	40.80	35.92
B_2T_5	70.77	1.53	524.33	342.33	44.87	37.60
B_2T_6	72.98	1.59	565.72	356.33	47.80	38.35
B_2T_7	72.10	1.62	623.92	385.67	47.93	39.75
CD (0.01)	NS	0.102	39.127	15.284	3.207	2.596

Effect of seed enhancement treatments

Normal tillage

All the pre-sowing seed enhancement treatment were found significantly improve the seed quality in terms of the plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant when was the wheat seed raised under normal tillage condition (table 2). Similar findings were also reported by Ahmadvand *et al.* (2012, sunflower) [5],

Farooq *et al.* (2006, rice) [9], Monel *et al.* (2011, sorghum) [18], Patel *et al.* (2017, maize) [20] and Singh *et al.* (2017, wheat) [25].

Treatment with $CaCl_2$ (2%) followed by bavistin results in highest percent improvement over control for plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant showed percent improvement 1.79, 23.45, 36.43, 10.60, 19.58 and 25.78 with values of 75.62 cm, 1.79 g, 682.75 g, 380.83, 52.53 and 45.03 percent respectively. Similar results were also found by Ajirloo *et al.* (2013, maize), Farooq *et al.* (2006, rice) [9], Jafar *et al.* (2012, wheat) [14], Pawar *et al.* (2003, sunflower) [21], Shehzad *et al*. (2012, sorghum) [24].

Next best treatment was hydration with distilled water followed by bavistin which showed significantly better performance & at par to $CaCl_2$ (2%) followed by bavistin for improving the plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant showed percent improvement of 1.49, 14.48, 14.35, 0.24, 12.29, and 16.17 with values of 75.40 cm, 1.66 g, 572.23 g, 345.17, 49.33, and 41.59 percent respectively over untreated seeds. These findings were strongly supported by Ajirloo *et al*. (2013, maize), Meena *et al*. (2013, wheat) [17], Toklu *et al.* (2015, wheat) [27], Patel *et al.* (2017, brinjal & tomato) [20], Yucel *et al.* (2012, lentil) [28].

Zero tillage

In the present study when wheat crop sown under zero tillage after treatment of seed with different pre-sowing seed enhancement treatments, it results in improvement of seed quality in terms of plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant (table 2).Poor crop establishment is a major problem in wheat production under zero tillage condition.

Seed treatments with $CaCl_2$ (2%) followed by bavistin significantly improved the all the seed quality parameters with percentage increment of 2.10, 14.89, 29.02, 12.71, 20.04 and 16.64 in plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant respectively over control with values of 72.10 cm, 1.62 g, 623.92 g, 385.67, 47.93 and 39.75 percent respectively.

Next to $CaCl_2$ (2%) followed by bavistin, hydration with distilled water followed by bavistin given better result which exhibited statistically at par to $CaCl_2$ (2%) followed by bavistin for plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant with percentage increment of 3.34, 12.77, 16.98, 4.14, 19.71 and 12.53 over untreated seeds with value of 72.98 cm, 1.59 g, 565.72 g, 356.33, 47.80 and 38.35 percent respectively.

It was very much clear from the findings of experiment that untreated seeds exhibited significantly inferior performance. Seed treated with $CaCl_2$ (2%) followed by bavistin gives better quality next to hydration with distilled water followed by bavistin, KNO_3(2%), KNO_3(2%) followed by bavistin, $CaCl_2$ (2%), distilled water, seed dressing with bavistin, that scored nearly similar values and were at par to control that plant height, seed yield per plant, seed yield per square meter, number of spike per square meter, number of seeds per spike and harvest index per plant respectively.

Conclusion

It was concluded from the present study that seed vigour potential of seed lot produced under zero tillage was comparatively inferior to that of normal tillage. Further seed enhancement treatment improved the seed vigour potential in both the tillage condition. Almost all the treatment has improved vigour potential significantly over control. Among all the treatments, KNO_3 (2%) was found to be best which was also at par with KNO_3 (2%) followed by seed dressing with Bavistin in both the conditions tillage condition. In the field parameters all the treatments, $CaCl_2$ (2%) followed by bavistin was found to be best which was also at par with hydration with distilled water followed by bavistin in both the tillage condition.

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