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Impact of hydropriming and organic manure on seed emergance, seed vigour and grain yield of wheat (*Triticum durum* L.) under rainfed condition

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Abstract
To evaluate the Impact of hydropriming and organic manure on seed emergance, seed vigour and grain yield of wheat (*Triticum durum* L.) under rainfed condition. The seed emergance, plant height, number of tillers per plant, spike length, number of spikelets per spike, number of seeds per spike, seed yield per plant, seed yield per ha, 1000 seed weight, seed germination percentage, root length, shoot length and seedling vigour index were found significantly due to hydropriming as well as with organic manures. Maximum plant height (101.80 cm), number of tillers per plant (13.03), spike length (11.87 cm), number of spikelets per spike (18.00), number of seeds /spike (42.85), seed yield per plant (7.60 g) and seed yield (28.85 q ha^{-1}) were recorded with the application of Hydropriming for 10 hours + FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1}(H_2M_4) followed by Hydropriming for 10 hours + Poultry manure @ 5 t ha^{-1}+ Vermicompost @ 5 t ha^{-1} (H_2M_5). However, plant height, spike length, number of spikelets per spike, number of seeds per spike, grain yield per plant and per ha. were recorded poor performance with the Hydropriming for 5 hours + FYM @ 10 t ha^{-1} (H_1M_1).

Keywords: wheat, hydropriming and organic manures, growth, grain yield and seed quality

Introduction
Wheat *Triticum aestivum* (L.) is one of the most important staple food crops of the world under diverse growing conditions of soil and climate. It is an excellent health-building food containing approximately, 78% carbohydrates, 12% protein, 2% fat and minerals each and considerable amount of vitamins (Kumar *et al*., 2011).

About 80 to 85% of wheat grains are ground into flour (atta) and consumed in the form of chapaties. Soft wheat is used for making chapaties, bread, cake, biscuits, pastry and other bakery products while, hard wheat is used for manufacturing rawa, suji and sewaya and straw is mainly used as fodder for livestock.

India stands second among wheat producing countries (after rice) with respect to area and production. In India wheat was grown over an area of 29.14 million hectares with production of 102.19 million tonnes with an average productivity of 3507 kg per ha. (Anonymous, 2020) [2]. In Uttar Pradesh, wheat is grown over an area 9.54 million hectares with a production of 32.75 million tonnes and with an average productivity of 3432 kg per ha which is much lower than national average (Anonymous, 2020) [2].

Organic agriculture is derived as a production system which largely excludes or completely avoids the use of synthetically compounded pesticides, fertilizers, growth regulators, preservatives and livestock feed additives, organic agriculture practices thus relay upon recycling of crop residues, animal manures, off-farm organic residues and wastes, bio-fertilizers exploitation of native soil fertility, non-pesticidal methods of pest control and weed management.

Seed priming resulting in faster development, earlier flowering and maturity and higher yields in barley Abdulrahmani *et al*., 2007 [3]. Harris *et al*. (1999) [9] demonstrated that on-farm seed priming (soaking seeds overnight in water) markedly improved establishment and early vigour of upland rice, maize and chickpea, resulting in faster development, earlier flowering and maturity and higher yields.

Material and Methods

A field experiment was conducted at Organic Research Farm, Institute of Agricultural Sciences, Bundelkhand University, Jhansi during 2019-20, to investigate the impact of hydropriming and organic manure on seed yield, vigour and field emergence of wheat (*Triticum durum* L.) under rainfed condition. The soil of experimental plots was red soil, (pH 7.2), low in organic carbon (0.63%), available nitrogen (326 kg/ha), available phosphorus (4.5 kg P_2O_5/ha) and medium in available potassium (87.0 kg K_2O/ha) content. The experiment was carried out in factorial randomized block design with three replications.

The treatments consisted of two hydropriming (H_1- Hydropriming for 5 hours and H_2- Hydropriming for 10 hours) and five organic nutrient management levels *viz*.

M_1- FYM @ 10 t ha^{-1},
M_2- Poultry manure @ 5 t ha^{-1},
M_3- Vermicompost @ 5 t ha^{-1},
M_4- FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1}, and M_5- Poultry manure @ 10 t ha^{-1}+ Vermicompost @ 5 t ha^{-1}).

Addition of these ten treatment combinations like FYM, Poultry manure and vermicompost was incorporated as per treatments and for hydropriming, wheat seeds were subjected to hydro-biopriming (distilled water) for 12 hours at 25 ^{0}C to 30 ^{0}C. For seed hydropriming; seeds were soaked in water for 12 hours, seeds were removed and dried at 25 ^{0}C for 24 hours in the laboratory to maintain original moisture level. The wheat variety HI-8759 were sown on 26th November 2019 at 22.5 cm row to row spacing by using recommended seed rate of 100 kg ha-1. Agronomic practices were adopted as per schedule. For recording growth character like plant height (cm), number of tillers per plant, yield attributing characters *viz*. spike length (cm), number of spikelet per spike, number of seed per spike, grain yield per plant (g), grain yield (q ha^{-1}) and 1000 seed weight (cm), seed quality parameters like germination percentage (%), root length (cm), shoot length (cm), seedling vigour index and seed emergence (%) were recorded as per schedule.

Result and Discussion

Plant height was found significantly (94.92 cm) with Hydropriming for 10 hours (H_2) than in Hydropriming for 5 hours (H_1) (87.81 cm). A significant results were found in number of effective tillers per plant by (12.80) in Hydropriming for 10 hours (H_2) than in Hydropriming for 5 hours (H_1) (12.14). Hamidi *et al*. (2013) [10] reported similar results Treated with seed soaking. It might be due to hydropriming increased imbibational processes of seed by which releases of hydrolizing enzymes which encourages faster germination. Organic sources of nutrients supply enhanced nutritional back-up to plant, which increase the photosynthetic process, stomatal regulation, enzymatic activities and hormonal regulation through reducing photorespiration.

A significant enhancement were noticed in yield attributing characters such as Spike length (11.44 cm), number of spikelets per spike (17.47), number of seeds per spike (41.65), seed yield per plant (6.54 g) and seed yield (27.58 q ha^{-1}) with Hydropriming for 10 hours (H_2) over Hydropriming for 5 hours (H_1) (10.12 cm, 16.12, 39.37, 5.18 g and 25.39 q ha^{-1}, respectively. Raj *et al*. (2013) [7], Atar and Akman (2014) [5] and Patra *et al.* (2016) [15] also reported similar results.

Seed quality parameters *viz.* 1000 seed weight, seed germination percentage, root length, shoot length, seedling vigour index and field emergence were reported significantly by 40.58 g, 94.73%, 14.76 cm, 12.59 cm, 2592.56 and 92.76%, respectively with the application of Hydropriming for 10 hours (H_2) than in Hydropriming for 5 hours (H_1) (38.31 g, 91.80%, 12.21 cm, 10.31 cm, 2076.79 and 90.01%. Above finding were also confirmed by Abnavi and Ghobadi (2012) [5] in wheat.

With the application of organic sources of nutrients such as FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1}(M_4) recorded significantly the highest plant height (95.64 cm) and number of tillers per plant (12.80) followed by M_5, M_2 and M_3 levels. While, the lowest plant height (87.97cm) and number of tillers per plant (11.81) in FYM @ 10 t ha^{-1}(M_1) level. Nag *et al* (2007) [15], Mehra and Singh (2007) [13] and Davari *et al*. (2012) [8] also confirmed by earlier.

This may be attributed by better physico-chemical properties of soil and nutrient availability after the decomposition of organic matter and supply of readily available nutrients through FYM and vermicompost.

A significant enhancement were noticed in the spike length (11.41 cm), number of spikelets per spike (17.48), number of seeds /spike (41.96), seed yield per plant (6.86 g), seed yield (27.82 q ha^{-1}) and thousand seed weight (40.82 g) were found in FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1} (M_4) followed by Poultry manure @ 10 t ha^{-1}+ Vermicompost @ 5 t ha^{-1} (M_5). While significantly lesser spike length (9.59 cm), number of spikelets per spike (15.60), number of seeds /spike (38.41), seed yield per plant (4.68 g), seed yield (24.41 q ha^{-1}) and thousand seed weight (37.24 g) were noticed in FYM @ 10 t ha^{-1} (M_5). Jala-Abadi *et al.* (2012) [11] and Kumar *et al.* (2013) [12] also found similar results.

A significant results were noticed in quality parameters (40.82 g, 95.25%, 15.25 cm, 12.78 cm, 2674.04 and 93.25%, respectively) with FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1} (M_4) followed by M_5, M_2 and M_3 levels whereas, they were the lowest (37.24 g, 90.03%, 11.06 cm, 9.25 cm, 1844.29 and 88.56%, respectively were recorded in FYM @ 10 t ha^{-1} (M_1). Biradar *et al*. (2001) [6] also found similar results.

Application of Hydropriming for 10 hours + FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1} (H_2M_4) recorded significantly higher plant height (61.65, 94.05 and 101.80 cm) and number of tillers per plant (14.87, 15.33 and 13.03) followed by Hydropriming for 10 hours + Poultry manure @ 5 t ha^{-1}+ Vermicompost @ 5 t ha^{-1}(H_2M_5). However, the lower plant height (45.52, 77.56 and 85.22 cm) and number of tillers per plant (11.24, 12.00 and 11.00) were reported with Hydropriming for 5 hours + Poultry manure @ 5 t ha^{-1}(H_1M_1) at 60, 90 DAS and at harvest, respectively. These results are also conformed by Patra *et al.* (2018) [16] in wheat**.**

Spike length (11.87 cm), number of spikelets per spike (18.00), number of seeds /spike (42.85), grain yield per plant (7.60 g) and grain yield (28.85 q ha^{-1} were recorded maximum with application of Hydropriming for 10 hours + FYM @ 10 t ha^{-1}+ Poultry manure @ 5 t ha^{-1}(H_2M_4) followed by Hydropriming for 10 hours + Poultry manure @ 5 t ha^{-1}+ Vermicompost @ 5 t ha^{-1} (H_2M_5). Whereas, the lower spike length (8.13 cm), number of spikelets per spike (14.13), number of seeds per spike (36.07), seed yield per plant (3.46 g) and seed yield (22.41 q ha^{-1}) were recorded in the Hydropriming for 5 hours + FYM @ 10 t ha^{-1} (H_1M_1). Channabasanagowda *et al.* (2008) [7] reported similar results in wheat**.**

A significant results were noted in thousand seed weight (35.08 g), germination percentage (96.72%), root length (8.71 cm), shoot length (7.08 cm), seedling vigour index (1368.28)

and field emergence (94.72%) were recorded in H_2M_4 followed by H_2M_5, H_2M_2 and H_2M_3 as against in H_1M_1 (35.08 g, 86.65%, 8.71 cm, 7.08 cm, 1368.28 and 85.71%, respectively interaction with treatments.

It might be due to hydropriming increased imbibational processes of seed by which releases of hydrolizing enzymes which promote faster germination. Organic sources of nutrients supply enhanced nutritional back-up to plant by secretion of major and minor elements, which increase the photosynthetic process, stomatal regulation, enzymatic activities and hormonal (increases the levels of auxins, gibberellin cytokinins and reduces the production of ethylene, ABA) regulation which increased cell division and cell enlargement by reducing photorespiration and transportation.

Table 1: Impact of hydropriming and organic manure on seed emergance, seed vigour and grain yield of wheat (*Triticum durum* L.) under rainfed condition.

Treatments	Plant Height	Number of tillers per plant	Spike length (cm)	Number of spikelets per spike	Number of seeds per spike	Seed yield per plant (g)	Seed yield (q ha^{-1})
Priming							
H1	87.81	12.14	10.12	16.12	39.37	5.18	25.39
H2	94.92	12.80	11.44	17.47	41.65	6.54	27.58
SEm±	0.54	0.09	0.14	0.12	0.22	0.11	0.18
CD at 5%	1.63	0.27	0.42	0.37	0.66	0.34	0.55
Organic manures							
M_1	87.97	11.81	9.59	15.60	38.41	4.68	24.41
M_2	90.47	12.50	10.86	16.86	40.67	5.87	26.67
M_3	90.12	12.55	10.89	16.89	40.46	5.76	26.50
M_4	95.64	12.80	11.41	17.48	41.96	6.86	27.82
M_5	92.61	12.69	11.15	17.15	41.04	6.13	27.04
SEm±	0.86	0.14	0.22	0.19	0.35	0.18	0.29
CD at 5%	2.57	0.42	0.67	0.57	1.05	0.54	0.87
Interaction							
H_1 M_1	85.22	11.00	8.13	14.13	36.07	3.46	22.41
H_1 M_2	87.28	12.23	10.29	16.29	39.56	5.16	25.56
H_1 M_3	87.68	12.44	10.54	16.54	39.99	5.54	26.06
H_1 M_4	89.49	12.56	10.96	16.96	41.12	6.12	26.79
H_1 M_5	89.36	12.46	10.67	16.67	40.15	5.61	26.15
H_2 M_1	90.72	12.62	11.06	17.06	40.74	5.90	26.41
H_2 M_2	93.67	12.78	11.43	17.43	41.79	6.57	27.79
H_2 M_3	92.56	12.66	11.24	17.24	40.93	5.98	26.93
H_2 M_4	101.80	13.03	11.87	18.00	42.85	7.60	28.85
H_2 M_5	95.85	12.92	11.62	17.62	41.94	6.65	27.94
SEm±	1.21	0.20	0.32	0.27	0.50	0.26	0.41
CD at 5%	2.63	0.60	0.95	0.80	1.48	0.77	1.24

Table 2: Impact of hydropriming and organic manure on seed emergance, seed vigour and grain yield of wheat (*Triticum durum* L.) under rainfed condition.

Treatments	1000 seed weight (g)	Germination percentage (%)	Root Length (cm)	Shoot length (cm)	Seed vigour index	Field emergence (%)
Priming						
H1	38.31	73.53(91.80)	12.21	10.31	2076.79	71.65(90.01)
H2	40.58	76.87(94.73)	14.76	12.59	2592.56	74.43(92.76)
SEm±	0.22	0.32	0.25	0.21	1.55	0.27
CD at 5%	0.64	0.94	0.74	0.62	4.60	0.80
Organic manures						
M_1	37.24	71.85(90.03)	11.06	9.25	1844.29	70.35(88.56)
M_2	39.89	75.68(93.86)	13.85	11.89	2418.15	73.43(91.86)
M_3	39.25	74.90(93.14)	13.21	11.25	2279.29	72.74(91.21)
M_4	40.82	77.64(95.25)	15.25	12.78	2674.04	74.90(93.25)
M_5	40.04	75.91(94.04)	14.04	12.07	2457.59	73.62(92.04)
SEm±	0.34	0.50	0.39	0.33	2.45	0.42
CD at 5%	1.02	1.49	1.16	0.99	7.28	1.26
Interaction						
H_1 M_1	35.08	68.60(86.65)	8.71	7.08	1368.28	67.77(85.71)
H_1 M_2	38.99	74.57(92.93)	12.93	10.96	2220.10	72.46(90.93)
H_1 M_3	38.56	74.08(92.94)	12.49	10.53	2129.12	72.02(90.49)
H_1 M_4	39.79	75.57(93.79)	13.79	11.81	2401.02	73.34(91.79)
H_1 M_5	39.15	74.81(93.15)	13.15	11.17	2265.41	72.67(91.15)
H_2 M_1	39.41	75.10(93.41)	13.41	11.43	2320.30	72.93(91.41)
H_2 M_2	40.79	76.80(94.79)	14.79	12.81	2616.20	74.41(92.79)
H_2 M_3	39.93	75.72(93.80)	13.93	11.97	2429.46	73.47(91.93)
H_2 M_4	41.85	79.71(96.72)	16.72	13.75	2947.06	76.47(94.72)
H_2 M_5	40.94	77.01(94.94)	14.94	12.97	2649.77	74.58(92.94)
SEm±	0.48	0.71	0.55	0.47	3.47	0.60
CD at 5%	1.44	2.11	1.65	1.40	10.30	1.79

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