Evaluation of seed priming and coating on emergence, yield and yield components of bread wheat (*Triticum aestivum* L.) in Northwest Ethiopia

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ABSTRACT

Bread wheat production is constrained by climate change impacts and diseases in Amhara region. Pre-farming seed treatments are practiced worldwide to avert their effects on wheat. A field experiment was conducted at Adet and Finoteselam research stations in 2014 main cropping season to evaluate the effects of seed priming and coating on emergence, yield and fussarium head scab (FHS) of bread wheat. Treatments via untreated seeds, water primed seeds, cow urine primed seeds, Dynamic 200FS coated seeds, water primed + Dynamic 200FS coated seeds, cow urine primed + Dynamic 200FS coated seeds, Dynamic 200FS + Disco™ AG Red L-431 coated seeds, water primed + Dynamic 200FS + Disco™ AG Red L-431 coated seeds, cow urine primed + Dynamic 200FS + Disco™ AG Red L-431 coated seeds, Dynamic 200 FS + Disco™ AG Red L-431 + Genius coat™ coated seeds, water primed + Dynamic 200 FS + Disco™ AG Red L-431 + Genius coat™ coated seeds and cow urine primed + Dynamic 200 FS + Disco™ AG Red L-431 + Genius coat™ coated seeds were tested using RCBD with three replications. ANOVA was computed using SAS version 9.0 and DMRT was used for mean separation at 1%. Significantly lower emergence, heading, maturity time were recorded from water primed seeds whereas significantly better tiller number, leaf area index, grain yield and lowest FHS incidence were recorded from Dynamic 200 FS+ Disco™ AG Red L-43 coated seeds. Indeed, Dynamic 200 FS + Disco™ AG Red L-431 coated seeds was economical for bread wheat production.

Keywords: Seed coating, Seed priming, Disco™ AG Red L-431, Dynamic 200 FS, Genius coat™

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INTRODUCTION

Ethiopia is the second largest wheat producing country in Africa (Abu and Teddy, 2014). The crop is widely grown in the highland and semi-highland areas of the Oromiya, Amhara, Southern and Tigray regions. Despite its cultivation, Ethiopia's annual wheat production is insufficient to meet domestic needs, forcing the country to import 30 to 50% of the annual wheat grain required (White *et al*., 2001). According to CSA (2013), the average productivity of wheat in Amahra region is about 1.78 t ha^{-1} which is lower than that of the yield obtained from national average (2.11 t/ha). This is because of biotic and abiotic factors that limits the productivity of the crop in the region. Bread wheat production is highly dependent on rain fall and is vulnerable to climate change impacts in Amhara region. Late onset and early cessation of rainfall is observed in Western Gojjam, Eastern Gojjam and Awi zone of Amahra region in recent years (Mulugojjam Taye *et al*., 2013). Woldeamlak

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Bewuket (2009) reported that wheat production was reduced by 28% in 1996 and 1997 from its 10 years mean, due to the variation of rain fall in the area. Moisture stress during planting season affects germination while stress during the latter crop growth stages appears to affect pollination, fertilization and grain filling (Tilahun Tadesse *et al*., 2013).

Wheat production in the Amhara region is also constrained by seed or/and soil borne diseases (Zewdie Bishaw *et al*., 2013). From 304 wheat samples tested for seed health, 31% (*Fusarum avenaceum*), 74% (*F. graminearum*), 13% (*F. nivale*), and 52% (*F. poae*) seed borne pathogens were recorded. The highest infection rate was observed on seed samples collected from Arsi (southeastern Oromia) followed by samples from Hulet Eju and Machakal districts in western Amhara region of Ethiopia (Zewdie Bishaw *et al*., 2013). To cope up the negative effects of unreliable and soil-borne diseases on food crop production, different adaptation measures are practiced to avert their effects. One of the most common adaptive measures that have been adopted by many countries is pre-farming seed treatments such as seed priming and coating (Hoseini *et al*., 2013). Seed priming is a technique by which seeds are partially hydrated to a point where germination-related metabolic processes begin but just prior to germination where radical emergence does not occur (Farooq *et al*., 2008). Several investigations confirmed that seed priming has many benefits including early emergence, good stand establishment, deeper roots, uniformity in emergence, initiation of reproductive organs, better competition with weed, early flowering and maturity, resistance to environmental stresses (Amin *et al*., 2012).

Seed treatment is an attractive method for introducing fungicides into a soil root environment since it protects the seeds from seed-borne and soil-borne pathogens and enables the seed to germinate and become established as a healthy seedling. Chemical seed coating is used to minimize the negative effect of early and terminal moisture on seed germination and stand establishment (Sarath *et al*., 2007). It also prevents diseases and pests, promote seedling growth and increase yields (Gesch and Archer, 2005). Although, the importance of seed priming and coating are so diverse, the applicability of the technologies are left far behind in Ethiopia in general and in Amhara region in particular. Therefore, the objective of the present experiment was to evaluate the effects of seed priming and coating on emergence, yield and yield components of bread wheat as well as to assess their impacts on fusarium head scab disease incidence caused by the pathogen *Fusarium graminearum* under natural conditions.

MATERIALS AND METHODS

A field experiment was conducted in two areas of Amhara National Regional State, namely Adet (11°16’ N latitude and 37°29’ E longitude, 2240 masl) and Finoteselam (10° 41’ N latitude and 37°15’ E longitude, 1941 masl) research stations (Figure 1). Adet has a mean temperature ranging from 10.39°C to 26.63°C and a total annual rainfall of 1180.8 mm while the mean temperature at Finoteselam is ranging from 12.36°C to 29.36°C with a total annual rain fall of 917 mm during 2014 cropping season (Table 1). The maximum rain fall received in the months of June to September for all locations. In both locations, the soil is deep with red-brown color (Nitosol).

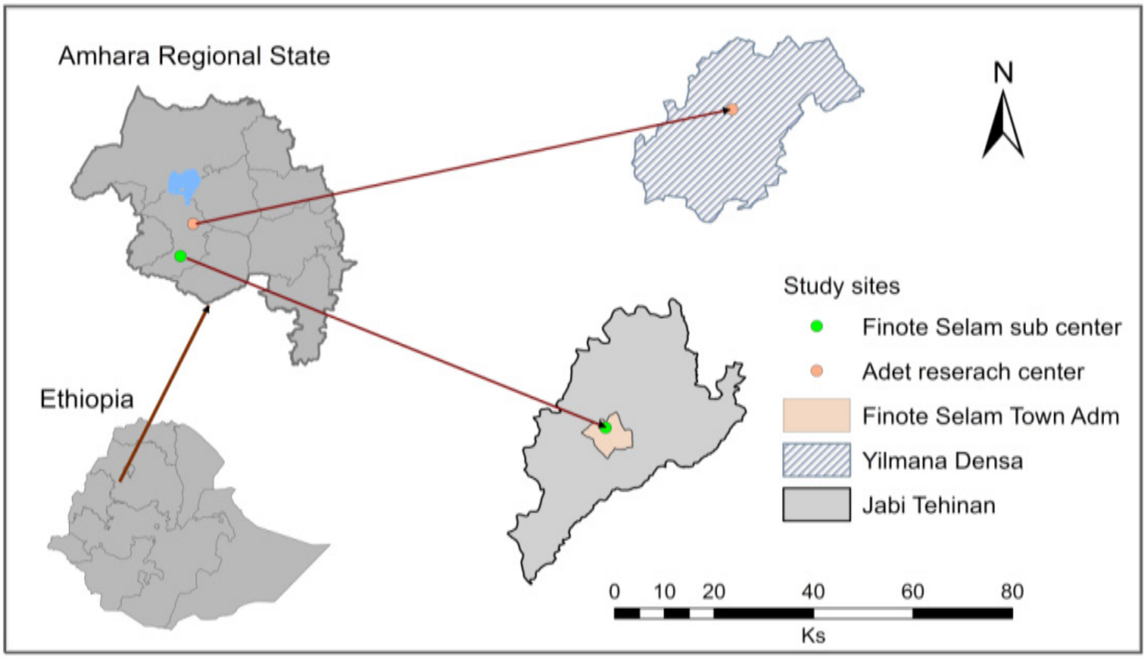

Figure 1: Map of experimental sites

Table 1: Monthly minimum and maximum temperature and rainfall for the year 2014 at Adet and Finoteselam

	Adet			Finoteselam		
Months	Rainfall (mm)	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Minimum temperature (°C)	Maximum temperature (°C)
January	0.00	7.50	27.80	0.00	12.00	31.50
February	3.50	7.70	29.30	0.00	13.00	32.70
March	114.20	11.40	29.00	29.40	13.90	30.10
April	85.60	12.90	29.00	112.20	13.90	30.00
May	188.30	13.30	27.10	59.70	6.90	23.50
June	130.60	13.00	26.30	120.90	14.80	26.30
July	210.80	13.20	24.10	240.80	14.30	23.00
August	200.20	12.00	23.30	272.10	12.90	26.00
September	151.80	11.40	24.10	82.10	13.40	24.40
October	49.50	9.10	26.30	0.00	12.40	28.00
November	46.30	6.80	27.00	0.00	10.90	30.00
December	0.00	6.40	26.30	0.00	9.90	30.30
Total	1180.80	124.70	319.60	917.20	148.30	352.30
Average	98.4	10.39	26.63	76.43	12.36	29.36

Source: National Metrological Agency, Bahir Dar Branch

Twelve treatments (Table 2) were evaluated for their effect on bread wheat using Randomized Complete Block Design (RCBD) with three replications. The blocks were separated by a 1 m wide-open space whereas the plots within a block were 0.4 m apart from each other. Each plot had a gross size of 2m in length and 3m in width. Every plot was accommodating 10 rows spaced 20 cm apart. The net plot size was 1.60 m x 2 m (central 8 rows of 2 m length). In accordance with the specifications of the design, a field layout was prepared and each treatment was assigned randomly to experimental plots within a block.

Table 2: Sets of treatments

Treatment number	Treatments
T_1	Untreated seeds (control)
T_2	primed seeds with water
T_3	Primed seeds with cow urine
T_4	seeds coated with Dynamic FS 200
T_5	Primed seeds with water + seeds coated with Dynamic 200FS
T_6	Primed seeds with cow urine + seeds coated with Dynamic 200FS
T_7	Seeds coated with Dynamic 200FS + Disco™ AG Red L-431
T_8	Primed seeds with water + seeds coated with Dynamic 200 FS + Disco™ AG Red L-431
T_9	Primed seeds with cow urine + seeds coated with Dynamic 200 FS + Disco™ AG Red L-431
T_{10}	Seeds coated with Dynamic 200 FS + Disco™ AG Red L-431 + Genius coat™
T_{11}	primed seeds with water + seeds coated with Dynamic 200 FS + Disco™ AG Red L-431 + Genius coat™, and
T_{12}	Primed seeds with cow urine +seeds coated with Dynamic 200 FS + Disco™ AG Red L-431 + Genius coat™

Water and fermented cow urine were used as seed priming materials whereas Disco™ AG Red L-431, Genius coat™ and Dynamic 200FS were used as seed coating materials. Genius coat™ is a growth stimulator hormone used in yield increment under suboptimal conditions. Disco™ AG Red L-431 is a well-balanced novel blend of specific humic and fulvic acids incorporated in a specially developed film coat formulation for use on cereals. Dynamic 200 FS is a formulation of Thiram 20% and Carbofuran 20% which is used as a seed treatment to prevent diseases and insects. Cow urine and water are used to enhance germination and improves other yield components of bread wheat. For primed seeds with water, the seeds were soaked with water for 12 hours while for the treatments having the cow urine priming; the seeds were soaked in 10% fermented cow urine for 12 hours. The seeds primed by soaking in water or cow urine were dried under shade condition to attain its original weight. In the cases of seed coating, the seeds were coated just before planting with Dynamic FS 200 @ 5 ml kg^{-1} of seed, Disco™ AG Red L-431 @ 2ml kg^{-1} of seed and Genius coat @ 5ml kg^{-1} of seed through mixing with water @ 6ml kg^{-1} of seed according to the treatments combination listed above using rotating drum. Bread wheat variety *TAY* was used as testing crop variety. Planting was done immediately after coating depending on the respective common planting dates of the study areas, July 1, 2014 at Adet and July 9, 2014 at Finoteselam.

The experimental field was prepared following the conventional tillage practice before planting. The land was leveled using manual power. Ditches and bunds were constructed for the whole experimental field and each replication. The recommended fertilizer dose of 92 kg ha^{-1} N and 46 kg ha^{-1} P_2O_5 was used for both locations. All the phosphorous and half of the nitrogen were applied during planting, while the remaining half of the N was applied at mid-tillering stage of the wheat. The source P_2O_5 was DAP whereas the source of N was urea and DAP. Seeds were hand drilled in row at seed rate of 150 kg ha^{-1} and covered with soil. One inter-cultivation at 3 weeks after sowing and hand weeding were carried out to keep the plots free from weeds and to provide better aeration. The next two hand weeding activities were operated at mid-tillering and booting stage.

Ten plants in each plot were randomly selected and tagged for collecting data including days to 50% emergence, days to 50% heading, days to 90% physiological maturity, plant height, tiller number, seeds per spike, spike length per plant, biomass yield, grain yield and thousand seed weight. Furthermore, leaf area, leaf area index, harvest index, fusarium head scab disease and economic data were taken in the following manner.

Leaf Area: leaf area at heading was measured using the mathematical equation developed by Yoshida (1981) as cited by Tilahun Tadesse *et al*. (2013). Leaf area (cm2) = L × W × 0.75: Where, L is the leaf length and W is the maximum width of the leaf.

Leaf Area Index (LAI): leaf area index (LAI) was also calculated using the formula of Yoshida (1981) as cited by Tilahun Tadesse *et al*. (2013). LAI=Sum of all leaves area on a plant /Ground area where collected plant stands on.

Harvest index (HI): From the yield of grains and biomass, the harvest index was calculated by using formula of Donald (1962) as:

HI = Grain yield (t ha^{-1}) / above ground biomass yield (t ha^{-1})

Fusarium head scab (FHS): FHS incidence was scored at heading stage of the crop by counting the number of infected plants from 100 plants in randomly selected rows and expressed as percentage.

Economic data: The prices in Ethiopian Birr of the inputs prevailed at the time of their use and the wheat grain and straw yield at the time of harvest under local market condition were considered for working out the cost of cultivation and gross benefits. The cost of Dynamic 200 FS, Disco™ AG Red L-431 and Genius coat™ were 480, 300 and 470 Ethiopian Birr per liter respectively. The cost of Labor to collect cow urine, to prime seeds with water and cow urine, to coat seeds with Dynamic 200 FS, Disco™ AG Red L-431 and Genius coat were 50 Ethiopian Birr each. Seed coating applying single Dynamic 200 FS, Disco™ AG Red L-431 and Genius coat and their mix up were the same i.e.50 Ethiopian Birr. The price of 1 kg of bread wheat grain and straw yield were 7 and 0.99 Ethiopian Birr, respectively.

The collected data were subjected to statistical analysis using SAS version 9. Homogeneity of error variances was tested using F test as described by Gomez and Gomez (1984) and the F-test was not significant. Thus, combined analysis of the two locations data was performed. Duncan Multiple Range Test (DMRT) at 1 and 5% probability level was carried out for mean separation. Disease data was transformed using log transformation. Correlation analysis was also carried out to study the nature and degree of relationship between yield and various growth and yield components. Correlation coefficient values (r) were calculated and test of significance was analyzed using Pearson correlation procedure. The mean grain and straw yield data across locations was adjusted down by 10% and subjected to partial budget analysis (CIMMYT, 1988). The cost varied for each treatment and treatments were ranked in order of ascending variable cost. Dominance analysis was used to eliminate those treatments which cost more, but which produced a lower net benefit than the lowest cost treatment. The marginal rate of return (MRR) was calculated for each non dominated treatment and a minimum acceptable MRR of 100% was assumed.

RESULTS AND DISCUSSION

Effects of Seed Priming and Coating on Bread wheat Phenology and Growth

Results of analysis of variance depicted that seed priming and coating had significant effects on days to 50% emergence, 50% heading and 90% physiological maturity ($P < 0.01$). Water primed seeds were earlier in emergence (6.33 days), heading (67.50 days) and maturity (112.83 days) time than the remaining treatments (Table 3). This was followed by cow urine primed seeds with an emergence, heading and maturity time of 7.17, 68.33 and 114.00 days, respectively. The promoted effect of seedling emergence, heading and maturity time when seeds primed with water might be the first activities of germination such as hydrolysis of glucose and mobilization of reserve proteins begins when water is entered in to the seed (Moradi *et al*., 2008). This resulted the beginning of transportation of stored materials, activation and synthesis of some enzymes, synthesis of DNA and RNA and the production of ATP in the seeds. So it increases uniform and quick emergence of seeds (Giri and Schilinger, 2003). Similarly, the shortest time for heading and maturity of water primed seeds might be due to its effect on fast emergence of the seeds at the beginning. The results of the present study is in line with the findings of Murungu and Madanzi (2010) on wheat and Tilahun Tadesse *et al.* (2013) on rice who reported that seeds soaked in water resulted in significantly earlier emergence, heading and maturity time than untreated seeds. In contrast cow urine primed seeds + Dynamic 200 FS coated seeds were late in emergence (9.50 days), heading (72.83 days) and maturity (117.00 days) time (Table 3). The results of this study indicated that seed priming alone is better than seed coating in shortening the time for emergence, heading and maturity. Fungicide and polymer seed coating did not speed the rate of emergence, heading and maturity. This might be due to coating was either too tough for the roots or shoot to penetrate, and/or was also too restrictive to gaseous exchange thereby causing prolonged time for emergence, heading and maturity. This is in line with findings by Sharratt and Gesch (2008) and Ingle *et al.* (2010) who confirmed that coated seeds could lead to delay in emergence time as compared to the uncoated seeds.

Effective tiller number and leaf area index were significantly influenced by seed priming and coating treatments ($p < 0.01$). However, plant height was not significant ($P > 0.05$). Tillering capacity is one of the determining components for bread wheat yielding ability. All treated seeds were better than the untreated seeds in number of effective tillers m^{-2}. The higher effective tiller number (250.50 m^{-2}) was recorded by Dynamic 200FS + Disco™ AG Red L-431 coated seeds followed by cow urine primed seeds + Dynamic 200FS + Disco™ AG Red L-431 coated seeds (248.33 m^{-2}) while the lower tiller number (171.83m^{-2}) was resulted from untreated seeds (Table 3).

The probable reason for better tiller number on seeds coated with Dynamic 200FS + Disco™ AG Red L-431 might be seed treatment with Dynamic 200FS (fungicide) can minimize the incidence of Fusarium head scab and the efficacy of Disco™ AG Red L-431 to protect Dynamic 200FS from dust off. For this reason, the treatment of seed with Dynamic 200FS fungicide is important because it can guarantee adequate populations of plants. Moreover, Disco™ AG Red L-431 is enabling plants to have longer roots for efficient utilization of fertilizers (INCOTECH). This resulted in profuse, strong and healthier tillers. The present study is in closed conformity of the findings of Schaafsma and Ilincic (2005) who stated that seeds treated with fungicides increased the number of tillers compared to non-treated seeds. Another study by Malaker and Mian (2009) have also noted that wheat seed treatment with either Vitavax-200 or Homai-8OWP fungicides were significantly increasing tiller number compared to untreated seeds.

Table 3: Effects of seed priming and coating on phenology and growth of bread wheat

Treatments	DE (days)	DH (days)	DM (days)	PH (cm)	TN (m^{-2})	LAI
Untreated seeds	8.17^{bcd}	71.83^{abc}	116.33^{a}	92.23	171.83^{d}	0.88^{c}
Water	6.33^{e}	67.50^{e}	112.83^{c}	97.23	242.83^{abc}	1.34^{ab}
Cow urine	7.17^{de}	68.33^{e}	114.00^{bc}	93.49	207.00^{c}	1.08^{ab}
Dynamic	8.50^{abc}	71.50^{abcd}	115.67^{ab}	93.50	234.17^{abc}	1.39^{ab}
Water + Dynamic	7.33^{d}	70.83^{cd}	115.50^{ab}	95.65	246.50^{ab}	1.41^{ab}
Cow urine + Dynamic	9.50^{a}	72.83^{ab}	117.00^{a}	95.78	210.67^{c}	1.28^{abc}
Dynamic + Disco	8.00^{bcd}	70.83^{cd}	115.83^{ab}	96.77	250.50^{a}	1.49^{ab}
water + Dynamic + Disco	7.67^{cd}	70.67^{b}	115.33^{ab}	94.96	237.33^{abc}	1.32^{ab}
Cow urine + Dynamic + Disco	8.83^{ab}	71.83^{abc}	116.50^{a}	94.56	248.33^{ab}	1.51^{ab}
Dynamic + Disco +Genius coat	8.83^{ab}	71.33^{bcd}	115.83^{ab}	95.61	231.33^{abc}	1.10^{abc}
Water + Dynamic+ Disco+Genius coat	7.67c	70.00^{d}	115.33^{ab}	93.99	231.33^{abc}	1.18^{abc}
Cow urine + Dynamic + Disco+ Genius coat	9.33^{a}	73.00^{a}	116.67^{a}	96.50	219.67^{abc}	1.54^{a}
Mean	8.11	70.88	115.57	95.02	227.63	1.29
CV (%)	7.37	1.31	1.01	3.32	9.71	19.50

Means followed by the same letter are not significantly difference among treatments.

Key: CV=coefficient of variation, DE=days to 50% emergence, DH=days to 50% heading, DM=days to 90% physiological maturity, PH=plant height, TN=tiller number, LAI=leaf area index

Leaf area index (LAI) is a measure of leafiness per unit ground area and determines the extent of photosynthetic, respiration, rain interception and related capacity of crops. All treated seeds gave higher LAI than the untreated control. The higher LAI (1.54) was obtained from cow urine primed seeds + Dynamic200FS +Disco™ AG Red L-431 + Genius coat™ coated seeds though it is not statistically significant with most of the treatments except for the control. The lowest LAI (0.88) was scored on untreated seeds (Table 3). The higher LAI on cow urine + Dynamic 200FS + Disco™ AG Red L-431 + Genius coat ™ treated seeds might be the efficacy of priming and coating materials in distributing dry matter into leaves of the plant. Because LAI is related to the supply and availability of N to plants which is supplied in seed priming with cow urine. Disco and genius coat are also known to enhance crop nutrition by influencing the water-retention capacity of the soil and by stimulating root development.

Improved nutrition may enable greater leaf area production that results in greater interception of light (Kumawat, 2009). The results of this study is in line with the finding of Rufino *et al.* (2013) on wheat who stated that significantly higher leaf area index was recorded from the combinations of fungicide + polymer and Zn + fungicide + polymer after 30 days after emergence compared with untreated seeds.

Effects of Seed Priming and Coating on Bread Wheat Grain Yield and Yield Components

Number of seeds spike^{-1} was significantly affected by seed priming and coating treatments ($P<0.01$). However, spike length and thousand seed weight were not significant ($P > 0.05$). The highest number of seeds spike^{-1} (56.52) was obtained from Dynamic 200FS + Disco™ AG Red L-431 coated seeds followed by cow urine primed + Dynamic 200FS + Disco™ AG Red L-431 coated seeds (55.91). The lowest number of seeds spike^{-1} was resulted from Dynamic 200 FS coated seeds (50.05) alone and untreated seeds (51.27) (Table 4).

Most of the treated seeds gave maximum number of seeds spike^{-1} as compared to untreated seeds. The probable reason for the treated seeds to give higher seeds per spike might be the efficacy of the treatments on the growth of spike length that produced higher seed number. It might be also the ability of Dynamic + Disco in enabling to distribute dry matter into seeds. The present finding is in closed conformity with the results of Thobunluepop *et al*. (2008) who reported that significantly maximum rice kernels panicle^{-1} was obtained from eugenol + chitosan-lignosulphonate polymer coated seeds than the untreated seeds. Malaker and Mian (2009) further reported that significantly the higher number of grains per spike on wheat was obtained from Vitavax-200 or Homai-8OWP fungicides coated seeds compared to untreated seeds.

Seed priming and coating had also significant effects on grain yield ($P \leq 0.01$) but not on above ground biomass yield (AGBY) and harvest index. Of course, all treatments gave the highest AGBY than the untreated seeds. All treatments gave significantly higher grain yield than the untreated seeds. The highest grain yield (4.70 t ha^{-1}) was obtained from seeds coated with Dynamic 200FS + Disco™ AG Red L-431 whereas the lowest grain yields (3.85 t ha^{-1}) was recorded from untreated seeds (Table 4). The advancement of grain yield with seed coating over untreated seeds might be due to polymer seed coating in combination with fungicides enable plants for better adaptation to environment. It also protects plants from fusarium head scab; improve stand quality and uniformity. This resulted in better plant growth, improved chlorophyll accumulation, yield attributes (number of effective tillers, leaf area index and number of seeds spike^{-1}); minerals uptake efficiency and physiological changes occurring in plants (Thobunluepop *et al.,* 2008). Fungicides are also reported to induce physiological changes in wheat plants and mostly increases yield of crops (Habermyer *et al.,* 1998 cited in Mubeen *et al.,* 2006). The results are also in agreement with the findings of Wiatrak (2013) who reported significant improved in yield of dry land winter wheat through the application of polymer seed coating. Moreover, Zeng and Zhao (2013) stated that wheat seed coating with natural polymer improve the wheat yield by 8% than untreated seeds.

Table 4: Effects of seed priming and coating on bread wheat grain yield and yield components

Treatments	Parameters						
	SLPP (cm)	SPS (Nos)	TSW (g)	SY t ha^{-1}	GY (t ha^{-1})	AGBY (t ha^{-1})	HI
Untreated seeds	9.14	51.27[bcd]	28.43	7.10	3.85[d]	10.95	0.36
Water	9.22	54.70[abcd]	30.65	8.14	4.42[abc]	12.56	0.37
Cow urine	8.92	52.78[abcd]	29.83	8.13	4.27[abcd]	12.40	0.35
Dynamic	9.24	50.05[d]	28.62	7.71	4.37[abc]	12.08	0.38
Water + Dynamic	9.35	53.58[abcd]	29.43	7.43	4.29[abcd]	11.72	0.38
Cow urine + Dynamic	9.31	55.83[ab]	28.50	7.42	4.51[abc]	11.93	0.39
Dynamic + Disco	9.59	56.52[a]	30.37	8.12	4.70[a]	12.82	0.38
water + Dynamic + Disco	9.10	53.60[abcd]	29.14	7.99	4.36[abc]	12.35	0.38
Cow urine + Dynamic + Disco	9.43	55.91[ab]	30.43	8.16	4.65[ab]	12.81	0.37
Dynamic + Disco +Genius coat	9.24	50.94[d]	29.47	7.51	4.21[bcd]	11.72	0.38
Water + Dynamic + Disco + Genius coat	9.13	52.58[abcd]	30.19	7.57	4.15[cd]	11.72	0.36
Cow urine + Dynamic + Disco+ Genius coat	9.38	55.33[abc]	30.11	8.23	4.27[abcd]	12.50	0.36
Mean	9.25	53.59	30.00	7.79	4.34	12.13	0.37
CV (%)	3.27	5.03	6.58	11.14	6.08	8.39	10.14

Means followed by the same letter are not significantly difference among treatments.

Key: CV=coefficient of variation, SLPP=spike length per plant, SPS=seed per spike, TSW=Thousand seed SY=straw yield, GY=Grain yield, AGBY=above ground biomass yield, HI=harvest index,

Effects of Seed Priming and Coating on Bread Wheat Fusarium Head Scab

There were significant effects ($P \leq 0.05$) of seed priming and coating materials on fusarum head scab (FHS) incidence on wheat. Maximum FHS incidence (2.67%) was recorded on untreated seeds while the minimum was recorded from seed coated with Dynamic + Disco (Table 5). The lowest FHS infection on seeds treated with Dynamic 200FS + Disco™ AG Red L-431 might be due stimulating effects the coating materials on the accumulation of phenolics and lignin which increased resistance in seedlings. The present result is in accordance with the finding of Menniti *et al.* (2003) who confirmed that effectiveness of triazole fungicides in controlling FHB under field conditions.

Table 5: Effects of seed priming and coating on *Fusarium* head scab disease

Treatments	Incidence of FHS (%)	Transformed data
Untreated seeds	2.67	0.51[a]
Water	1.67	0.40[ab]
Cow urine	2.17	0.49[ab]
Dynamic	1.67	0.41[ab]
Water + Dynamic	2.33	0.49[ab]
Cow urine + Dynamic	1.33	0.35[ab]
Dynamic + Disco	1.00	0.30[b]
water + Dynamic + Disco	2.33	0.51[a]
Cow urine + Dynamic + Disco	1.33	0.36[ab]
Dynamic + Disco +Genius coat	1.50	0.37[ab]
Water + Dynamic + Disco + Genius coat	1.33	0.37[ab]
Cow urine + Dynamic + Disco+ Genius coat	1.67	0.37[ab]
Mean	1.72	0.37[ab]
CV (%)		28.30

Means followed by the same letter are not significantly difference among treatments.
***Key:** CV=coefficient of variation, FHS=Fusarium head scab*

Economic Analysis of Grain and Straw Yield in Response to Seed Priming and Coating Materials

The economic analysis revealed that the best economical seed treatment materials were seeds coated with Dynamic 200FS + Disco™ AG Red L-431 that gave the maximum grain yield of 4.7 t ha^{-1} and straw yield of 8.12 t ha^{-1} with the net benefit value of 36418 Birr ha^{-1} and a MRR 288 % (Table 6). The lower economic value was obtained from untreated seeds having a grain yield of 3.85 t ha^{-1} and straw yield of 7.10 t ha^{-1} with a net benefit value of 30645 Birr ha^{-1}. The highest net benefit from Dynamic 200FS + Disco™ AG Red L-431 treated seeds might be due to the efficacy of the chemicals in increasing tillering capacity, leaf area index of bread wheat resulted higher grain and straw yield in response to the existing situation as well as higher market price of wheat grain and straw and affordable price of commercial seed coating chemicals.

Table 6: Total variable cost, gross benefit, net benefits and marginal rate of return for different seed priming and coating materials in response to grain and straw yield of bread wheat

Treatments	AGY (t ha^{-1})	ASY (t ha^{-1})	TVC (ETB)	GB (ETB)	NB (ETB)	MRR (%)
Untreated seeds	3.47	6.39	0	30645	30645	-
Water	3.98	7.33	50	35172	35122	8954
Cow urine	3.84	7.32	100	34218	34118**D**	-
Dynamic	3.93	6.94	410	34470	34060**D**	-
Water + Dynamic	3.86	6.69	460	33714	33254**D**	-
Cow urine + Dynamic	4.06	6.68	510	35091	34581**D**	-
Dynamic + Disco	4.23	7.31	500	36918	36418	288
Water + Dynamic + Disco	3.92	7.19	550	34659	34109**D**	**-**
Cow urine + Dynamic + Disco	4.19	7.34	600	36639	36039**D**	-
Dynamic + Disco +Genius coat	3.79	6.76	852	33282	32430**D**	-
Water + Dynamic + Disco + Genius coat	3.74	6.81	902	33021	32119**D**	-
Cow urine + Dynamic + Disco+ Genius coat	3.84	7.41	952	34308	33356**D**	-

Key: AGY=adjusted grain yield, ASY=adjusted straw yield, TVC= total variable cost, GB=gross benefit, NB= net benefit, ETB=Ethiopian birr, D=dominated treatment, MRR=marginal rate of return

Correlations among Bread Wheat Yield and Yield Components

The correlation among bread wheat agronomic parameters was quantified and strong correlation was observed between some of bread wheat yield parameters. Grain yield was highly and positively correlated with tiller number (r=0.71), leaf area index (r=0.81), spike let number (r=0.83), seed per spike (r=0.82) and 1000 seed weight (r=79).

CONCLUSIONS

In conclusion, priming bread wheat seeds with water reduced the time for emergence, heading and maturity while Dynamic 200FS + Disco™ AG Red L-431 seed coating increased bread wheat tiller number, leaf area index, grain yield and also suppressed fusarium head scab incidence. Dynamic 200FS + Disco™ AG Red L-431 is the most economically profitable treatment. Based on agronomic performance, disease suppressing and economic feasibility the result of the present study indicates the superiority of Dynamic 200FS + Disco™ AG Red L-431 seed coating for bread wheat production. Water priming is also the best for early emergence and better grain yield. The current study also indicated the need for further studies on contrasting environments using susceptible bread wheat varieties for major seed and soil borne diseases.

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