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Germination and Early Seedling Growth of Bread Wheat (Triticum aestivum L) as Affected by Seed priming and Coating

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Abstract
A laboratory experiment was conducted at Bahir Dar seed laboratory in 2014 to evaluate the effects of seed priming and coating on germination and early seedling growth of bread wheat (Var., Tay). Water and fermented cow urine were used as priming materials whereas Dynamic, Disco and Genius coat were used as coating materials. Treatments consisted of untreated seeds (T_1), water primed seeds (T_2), cow urine primed seeds(T_3), Dynamic coated seeds (T_4), water primed + Dynamic coated seeds (T_5), cow urine primed + Dynamic coated seeds (T_6), Dynamic + Disco coated seeds (T_7), water primed + Dynamic + Disco coated seeds (T_8), cow urine primed + Dynamic + Disco coated seeds (T_9), Dynamic + Disco + Genius coat coated seeds(T_{10}); water primed + Dynamic + Disco + Genius coat coated seeds (T_{11}) and cow urine primed + Dynamic + Disco + Genius coat coated seeds (T_{12}) were tested using completely randomized design with four replications. Physiological quality data like germination percentage, speed of germination, root length, shoot length, vigor index were taken. Analysis of variance for all parameters was computed with SAS version 9.0 and mean separation was done using Duncan's Multiple Range Test at 1 and 5% probability level. The study revealed that germination percentage, speed of germination, vigor index of bread wheat were significantly ($p<0.01$) affected by seed priming and coating treatments. From this experiment, higher germination percentage (93.75%) and speed of germination (34.27) was recorded by primed seeds with water. However, the root length (23.38 cm), shoot length (19.53 cm) and vigor index (3852.5) of bread wheat was higher for seeds coated with Dynamic + Disco.
Keywords: Seed priming, Seed coating, Vigor index, Dynamic, Disco, Genius coat

1. INTRODUCTION

Bread wheat (*Triticum aestivum* L) is cultivated in a wide range of environmental conditions in all around the world. Land allocated for wheat production in the world is more than any other plants (Mollasadeghi and Elyasi, 2014). Ethiopia is sub-Saharan Africa's largest producer of wheat. However, the productivity of this crop is low as compared to its potential due to low soil fertility, pests and diseases, poor seed bed preparations and poor rain fall distribution and inadequate soil moisture which results poor stand count and non-uniform stand establishment (Tanner *et al.,* 1990). However, early seedling emergence and uniform stand establishment are the major contributors for grain yield, quality and ultimately used for annual crops (Shehzad *et al.*, 2012).

Conditions after sowing had a large influence on the emergence and seedling vigor and speed of germination and emergence was an important determinant of successful establishment. Rapidly germinating seedlings could emerge and produce deep root systems before the upper layers of the soil dry out, hardened or become dangerously hot (Murungu, 2011). For this, pre-farming seed treatments such as seed priming (Askari and Farahmand, 2012) and coating (Gustafson, 2006) are known to improve seed performance under stressed environmental conditions. Seed priming is a technique by which seeds are partially hydrated to modulate pre-germination metabolic activity but prior to radicle emergence (Farooq *et al.,* 2008). This decreases the time that the seed spends in the seedbed simply imbibing water. So, by reducing the imbibition time through seed priming, germination rate of seed can be increased and seedlings emergence improved (Hartman *et al.,* 2002). Primed seeds generally induce the establishment of more rapid and vigorous seedling than dry seeds (Musa *et al.,* 2001).

Seeds can be primed using different media such as tap water (hydro-priming), low water potential solutions (osmo-priming) such as polyethylene glycol or salt solutions (KNO_3, KCl, $MgSO_4$, $CaCl_2$ and NaCl), solid matrix (matri-priming) and plant growth regulators (hormonal priming) (Farooq *et al*., 2006). Hydro-priming is the simplest approach to hydrate seeds and minimize the use of chemicals. It ensured rapid and uniform germination accompanied with low abnormal seedling percentage (Shivankar *et al.,* 2003). Hydro-priming enhanced seedling emergence, establishment and growth performance of crops on durum wheat and barley (Naceur, 2012) and rice (Ibrahim *et al.,* 2013). Seed osmo-priming with cow urine is also known to have beneficial effect on germination of crops. The application of cow urine as seed priming for maize gave higher emergence percentage (Saidu, 2009). Sharma and Deshpande (2006) reported that soaked pigeon pea seeds in 10% cow urine significantly enhanced seed germination, shoot length, root length and vigor index.

Seed coating using chemicals and biochemical is another seed treatment method used to grow crops under stress environment. Seed coating is a process in which a thin and consistent layer of a special material covers on the surface of the seed which creates a suitable living environment (Hoseini *et al.,* 2013). Several

research findings have verified the satisfactory effects of seed coating on seed germination, seedling growth, root and shoot growth, leaf area, dry biomass and increase in yield different crops. Wheat seed coating with natural polymer enhance seed germination rate by 5%, (Zeng and Zhao, 2013). Moreover, Mehrabi and Chaichi (2011) reported that better performance in speed of germination of *Onobrychis Sativa* seeds coated with different coating materials in both normal and drought stressed conditions.

Although the effects of priming and coating materials on germination and related process of some seed crops has been studied, but relatively little information is available on the invigorating of bread wheat seeds in Ethiopia in general and in Amahra region in particular. Therefore, this study aims to clarify the effect of seed priming and coating on germination percentage, speed of germination and seedling vigor of bread wheat.

2. MATERIALS AND METHODS

A laboratory experiment was conducted at Amhara National Regional State Seed Laboratory, located at the regional town of Bahir Dar. Seeds of bread wheat cultivar namely; *TAY* released by Adet Agricultural Research Center was used as testing variety. Water and fermented cow urine were used as seed priming materials whereas Disco, Genius coat and Dynamic 200 FS were used as seed coating materials. Genius coat is a growth stimulator hormone used in yield increment under suboptimal conditions. Disco 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 pests. Twelve treatments were evaluated for their effects on physiological quality of bread wheat (Table 1).

The seed weighed for each treatment was soaked with tap water and 10% fermented cow urine. For primed seeds with tap water, the seeds were soaked for 12 hours in tap water while for the treatments having 10% fermented cow urine, the seeds were soaked for 12 hours in cow urine. The seeds primed by tap 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 set up mentioned in table 1 using rotating drum.

Table 1: Treatments

Treatments	Description
T_1	Untreated seeds
T_2	Primed seeds with water
T_3	Primed seeds with fermented cow urine
T_4	Seeds coated with Dynamic 200 FS
T_5	Primed seeds with water + seeds coated with Dynamic 200 FS
T_6	Primed seeds with cow urine + seeds coated with Dynamic 200 FS
T_7	Seeds coated with Dynamic 200 FS + 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 ™
T_{12}	Primed seed with cow urine +seeds coated with Dynamic 200 FS+ Disco™ AG Red L-431+Genius coat ™

The experiment was conducted using completely randomized design (CRD) with four replications under room temperature about 25°C. Four hundred seed were counted from each treatment and divided into four replicates of each hundred seeds. The seeds were sown in sieved sterilized moist sand medium using germination box. The first count was done at 4th day after planting and final count was done at 7th day to calculate germination percentage. Their respective percentages were calculated for all four replications according to ISTA (1985) as follows:

$$\text{Germination (\%)} = \frac{\text{Total number of normal seedling}}{\text{Total number of seeds planted}} \times 100$$

Root length and shoot length were measured from ten normal seedlings by taking randomly from each replication of the treatments after germination test through hand curved the germination box and after removing the sand and dead seed from the root. The root length was measured from the tip of the primary root to base of hypocotyl with the help of a ruler and mean root length was also expressed in centimeters (cm). Similarly, ten normal seedlings used for root length measure were used for the measurement of shoot length. The shoot length was measured form the tip of the primary leaf to the base of the hypocotyls and mean shoot length was also

expressed in centimeter (cm). Then the seeding vigor index expressed in number was calculated by the formula developed by Abdul-Baki and Anderson (1973) as follows.

VI= Standard germination × mean seedling length (roots + shoots length)

Speed of germination was calculated by counting the number of normal germinating seedlings starting from 4 days after sowing and ending at 14 days after incubation (ISTA, 2008). Speed of germination was also calculated by dividing the number of normal seedlings tagged each day to the number of days in which they tagged (Maguire, 1962).

$$SPG = \frac{\text{Number of normal seedlings}}{\text{Days of first count}} + \ldots + \frac{\text{Number of normal seedlings}}{\text{Days of final count}}$$

The data collected from the experiment were subjected to statistical analysis. Analysis of variance (ANOVA) was computed for all data using SAS (version 9) software. Duncan Multiple Range Test (DMRT) at 1 and 5% probability level was carried out for mean separation.

3. RESULTS AND DISCUSSION

The means comparison between different seed priming and coating treatments on germination percentage of bread wheat are presented in Fig 1. Results of this study exhibited that germination percentage between treatments was significant (P<0.01). This figure indicate that maximum germination percentage was observed on hydro-primed seeds + Dynamic coated seeds and hydro primed seeds + Dynamic and Disco coated seeds while the lower germination percentage (84.25%) was recorded on cow urine primed seeds + Dynamic coated seeds. It is possible that the positive effect on germination percentage by hydro primed seeds plus Dynamic coated seeds might be due to the role of water during priming in influencing the permeability of the membranes which ultimately leads to activation of enzymes involved in protein synthesis and carbohydrate metabolism. In contrary, coated seeds germinated poorly, regardless of water primed seeds. Similarly, cow urine primed seeds + Dynamic coated seeds germinated poorly as it might be due to their negative synergetic effect on the activation of enzymes. This result was in closed conformity with the findings of Valdes *et al.,* (1985) who stated that priming improves seed germination regardless of film coating. Similar results were reported by Janmohammadi *et al.* (2008) who stated that hydro-priming significantly improved seed germination percentage. Consistent with our results, similar results were also reported by Pirasteh *et al.* (2013) and Hamidi *et al. (*2013) who stated that hydro-priming had positive effect in increasing germination percentage.

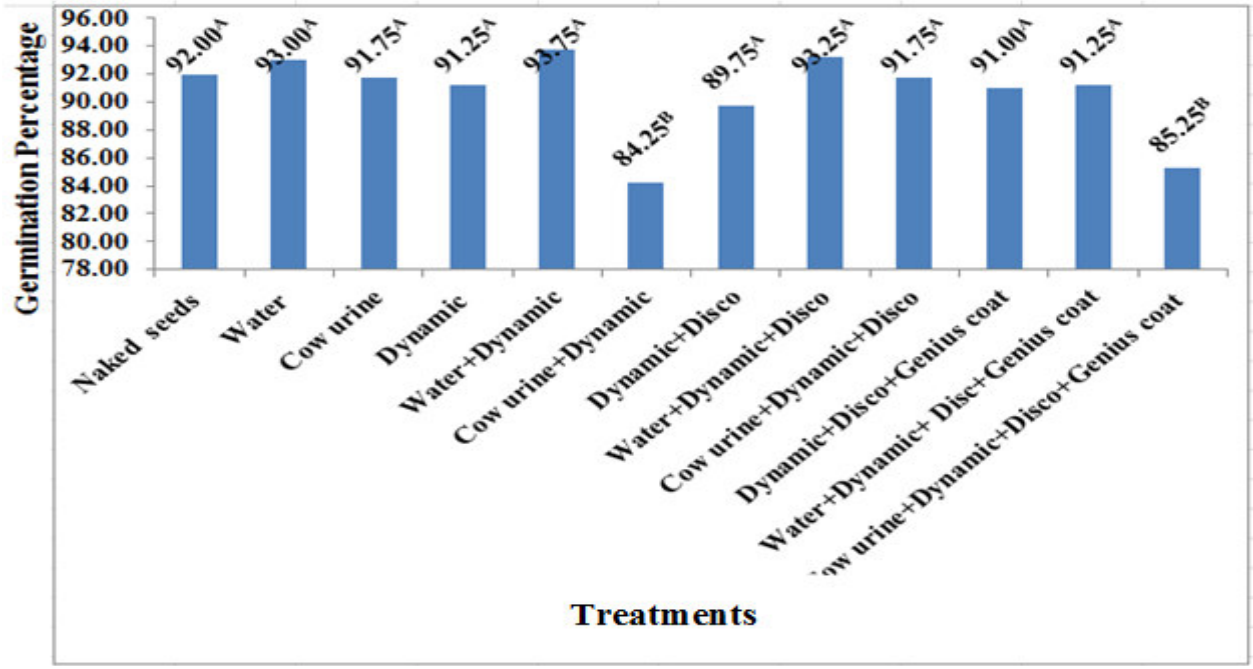

Fig 1: Effect of seed priming and coating treatments on germination percentage of bread wheat

The means comparison between seed priming and coating treatments on speed of germination of bread wheat are presented in Fig 2. Results showed that speed of germination between treatments was significant (P<0.01). Film coating generally had a negative effect on germination speed. The reduction in speed of germination on treatments receiving coated seeds alone might be due to the restriction/ barrier imposed by the coating material resulting slow moisture absorption and restrict oxygen diffusion to the embryo. Similarly cow

urine primed + Dynamic coated seeds reduced the speed of germination as their might be have negative synergetic effect on the physiology of seeds besides to the restriction of moisture absorption and oxygen diffusion. Valdes *et al.* (1985) reported that film coated seeds delayed in speed of germination. In contrast, Maximum speed of germination was recorded on water primed seeds alone and water primed + Dynamic coated seeds. However, in this investigation, all treatments receiving water primed seeds alone and water primed seeds in combination with Dynamic, Disco and Genius coat were better in germination speed of bread wheat. The high speed of germination in treatments receiving water might be due to advancement in the physiology of germination during soaking. The results of this study is in line with the findings of Moradi and Younesi (2009) who stated significant effect of seed priming on percentage and speed of emergence. Similar results were reported by Naceur (2012) who reported that speed of germination was enhanced by hydro-priming as compared with unprimed durum wheat and barley seeds.

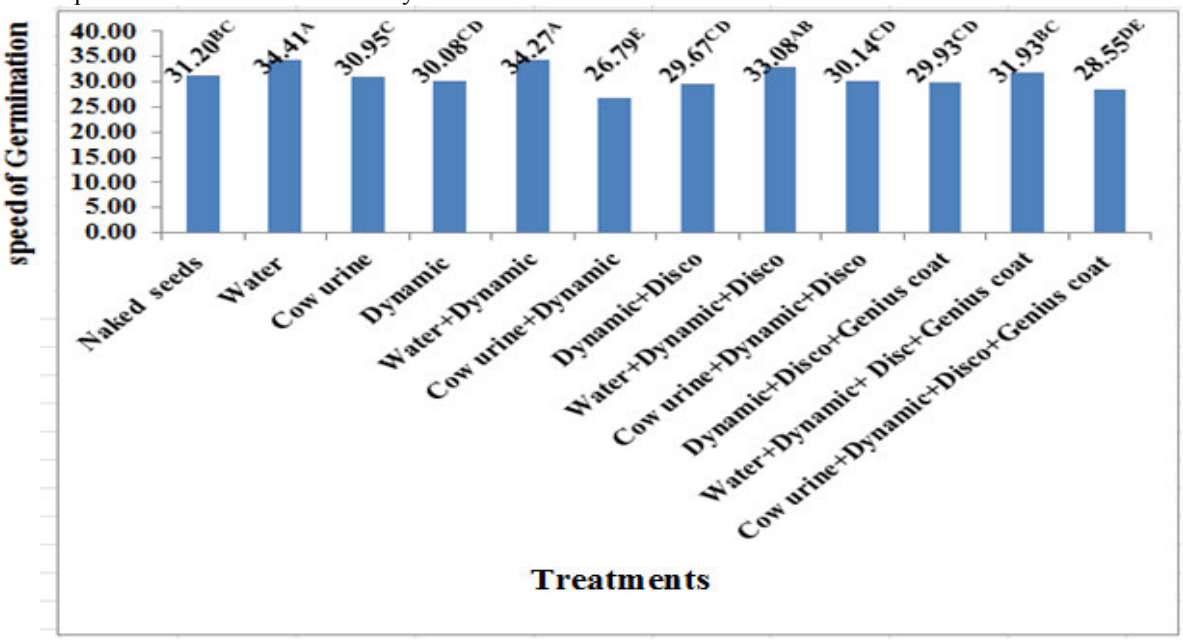

Fig 2: Effect of seed priming and coating treatments on bread wheat germination speed

The means comparison between seed priming and coating treatments on root length of bread wheat are presented in Fig 3. Results showed that root length between treatment was not significant ($P<0.05$). However, there was a numerical variation among treatments. Numerically, the highest root length (23.38 cm) was measured from Dynamic + Disco coated seeds while the lowest root length (18.75 cm) was measured from untreated/naked seeds. This result is in line with the work of Pariyar *et al*. (2014) who stated that thiabendazole fungicides seed coating has no significant effect on root length.

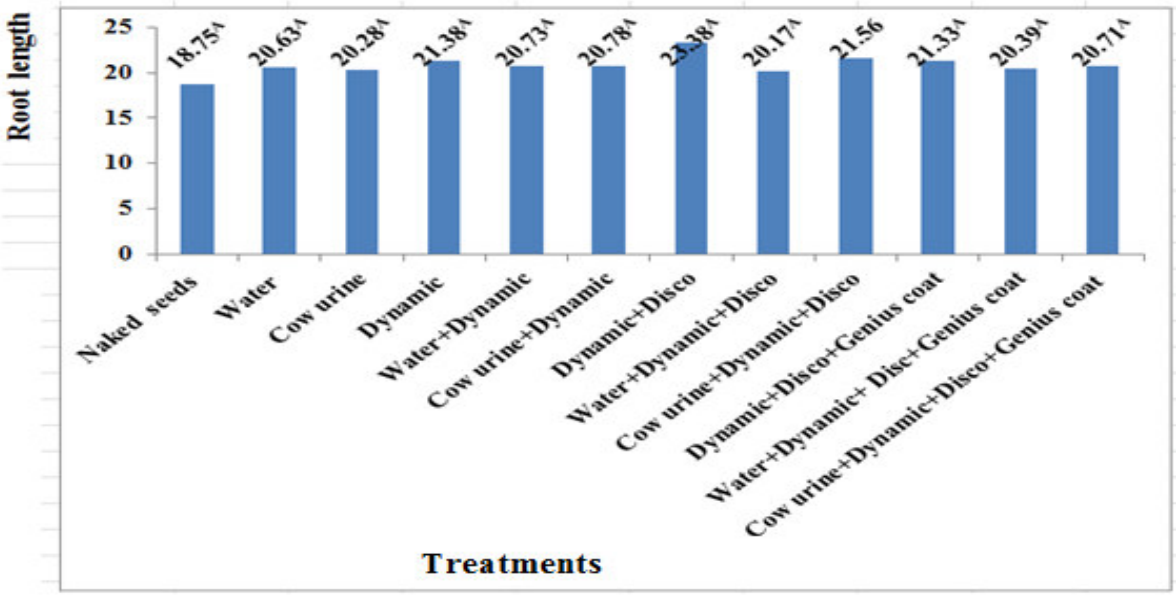

Fig 3: Effect of seed priming and coating treatments on bread wheat root length

The results on shoot length as influenced by seed priming and coating are presented in figure 4. Seed priming and coating exhibited significant effects (P< 0.01) on shoot length of bread wheat. Among the treatments Dynamic + Disco coated seeds recorded the highest shoot length (19.53 cm) while the shortest shoot length (18.09 cm) was measured from hydro-primed + Dynamic coated seeds. In this study, most of the treatments exhibited higher shoot length than the untreated control. The results of this study is in conformity with the work of Kaushik *et al.* (2014) who found that cotton treated with polymer treatment @ 9 ml +thiram @ 2 g per kg of seed recorded significantly higher values of shoot length.

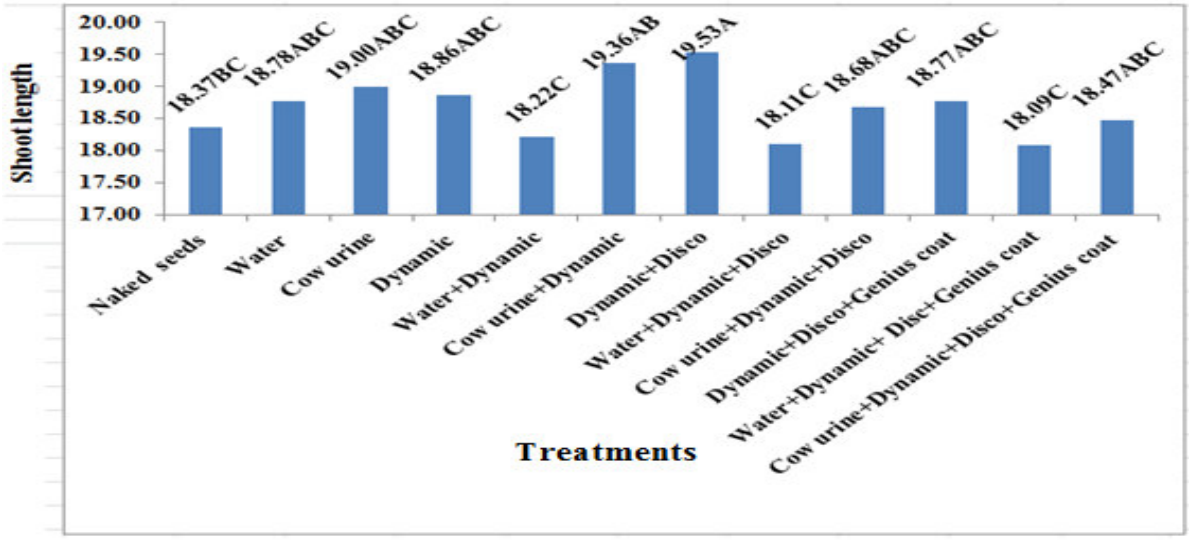

Fig 4: Effect of seed priming and coating treatments on bread wheat shoot length

The data on seedling length as influenced by seed priming and coating are presented in Fig.4 Seed priming and coating treatments revealed significant effects (P< 0.01) on seedling length of bread wheat. In this regards, all treatments exhibited higher seedling length than the untreated control. Among the seed priming and coating treatments, T_7 (Dynamic+ Disco coated seeds) recorded the highest seedling length (42.89 cm) while the shortest seedling height (38.12 cm) was exhibited by the untreated seeds.

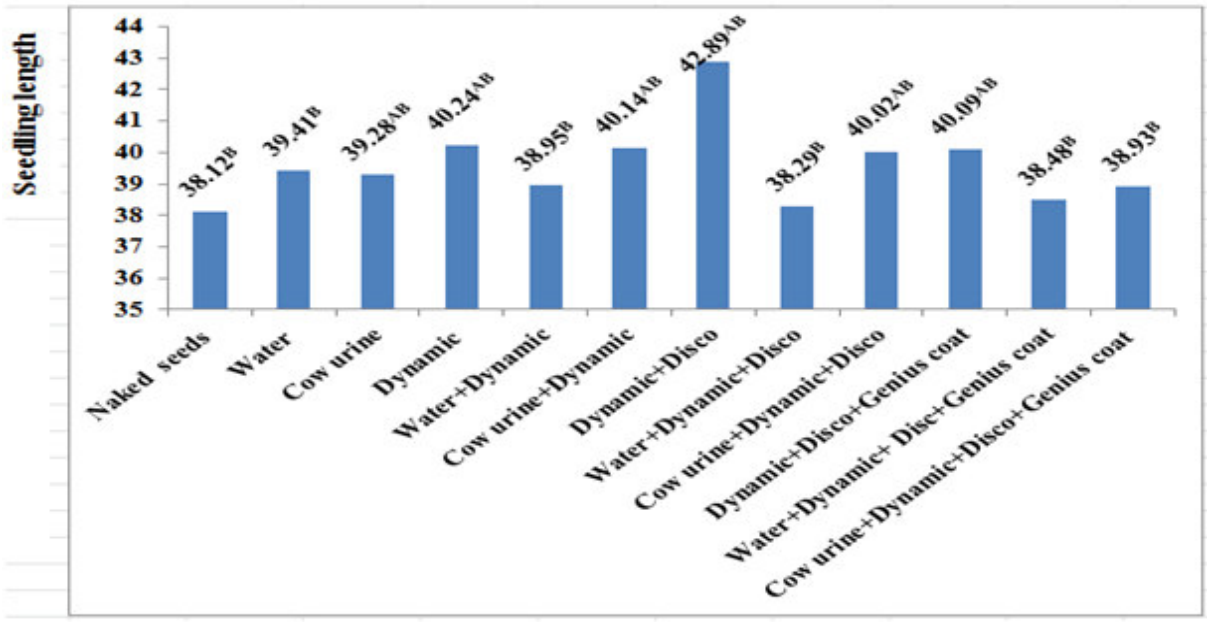

Fig 5: Effect of seed priming and coating treatments on bread wheat seedling length

The data on vigor index as influenced by seed priming and coating are presented in Fig. 6 Seed priming and coating exhibited significant effects (P< 0.01) on bread wheat vigor index. Among the seed priming and coating treatments, T_7 (seeds coated with Dynamic+ Disco) recorded higher vigor index (3852.5) while the lowest vigor index (3315.1) was recorded by T_{12} (primed seeds with cow urine + seeds coated with Dynamic + Disco + Genius coat). However except T_6 and T_{12}, all the treated seeds exhibited higher vigor index than the untreated control. The probable reason for high vigor index on coated seeds with Dynamic+ Disco might be

their efficacy in increasing seedling length resulting better vigor of wheat seedlings. The results of this study is in closed conformity with the findings of Rahraw *et al.* (2013) who observed significant differences in wheat seed vigor due to seed treatments. Similar results were reported by Kunkur *et al.* (2006) who stated that significantly higher vigor index was recorded in the seeds coated with polymer at a rate of 5.00 g kg^{-1} of seeds + thiram at a rate of 1.50 g kg^{-1} of seeds as compared to control. Kaushik *et al.* (2014) had also recorded higher vigor index on cotton with polymer coating @ 9 ml + thiram @ 2 g kg^{-1} of seeds.

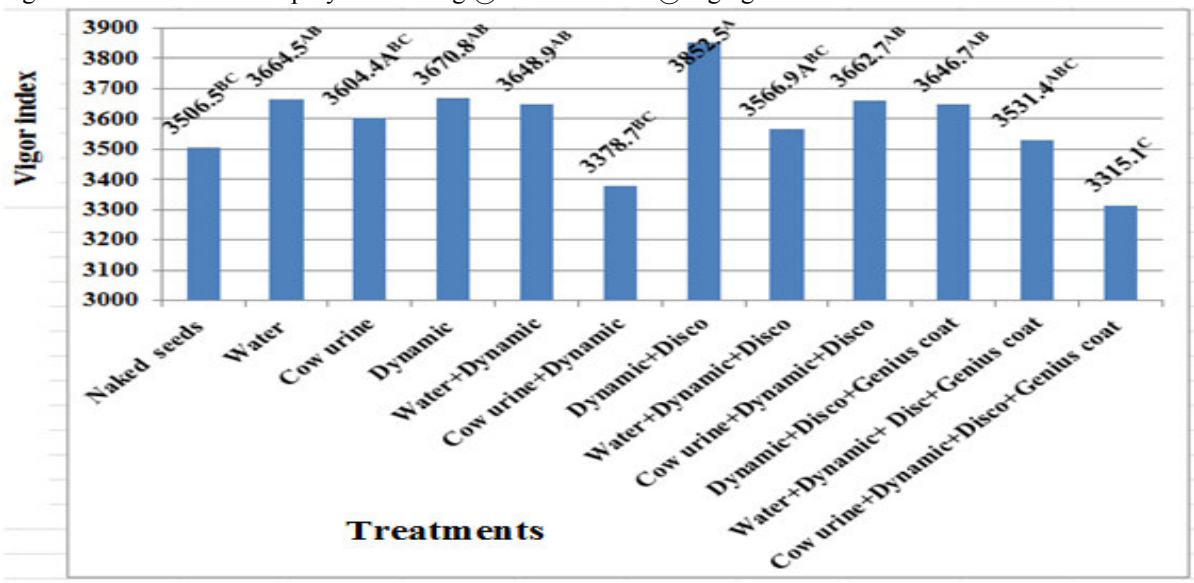

Fig 6: Effect of seed priming and coating treatments on bread wheat vigor index

4. CONCLUSION

In conclusion, seed priming and coating is working in improving vigor, speed of germination and germination percentage of bread wheat. Primed seeds with water alone and in combination with Dynamic, Disco and genius coat improved the percentage and speed of seed germination. The root length, shoot length and vigor index of bread wheat was higher for seeds treated with Dynamic+ Disco. Primed seed with water was found to be promising for early emergence otherwise Dynamic + Disco coated seed is better to improve bread wheat seed vigor.

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