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Effects of Seed Dressing and Storage Duration on Different Seed Quality Parameters of Faba Bean (*Vicia faba* L.)

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Abstract: Seed storage duration is a critical issue to be considered for different seed producer and the postharvest quality of legume seeds is strongly influenced by storage conditions. Maintaining the quality of seed is depend on many environmental factors, some of them are moisture, temperature, humidity, and storage conditions. Even though these factors are properly accounted for seed, quality may still be reduced by certain seed borne diseases or destroyed by insects and other pests. This study was conducted to evaluate the combination effect of seed dressing and storage time on Chalew variety of faba bean. Five different fungicide were used to dress the seed (F1, F2, F3, F4, F5 and F0 as control) and three storage duration (M0, M6 and M12) were used to determine the seed quality attribute's under laboratory. RCBD design in factorial arrangement with three replication was used. Statistix 10 software was used for data Analysis. The mean square revealed that seed dressing had significant difference on seed quality attributes like (MC, HLW, Shoot length, Fresh weight and dry weight of seed ling and highly significant difference on Germination (%) and Root length of the seedling, while it had no significant variation on TSW. The storage duration possessed significant variation on MC and Fresh weight of seedling while showed highly significant variation was observed for Germination (%), and Root length of seedling and no significant variation for other seed quality attributes. Significant variation was observed on MC and seed germination while highly significant differences observed on % dead seeds due use combination of storage duration and fungicide treatment. Dynamic 400 FS can sustain the Germination ability and vigor indexI&II of the faba bean followed by Mancozabe 80Wp and proseed plus63WS among the fungicide used.

Keywords: Seed Dressing, Faba Bean, Storage Duration, Seedling

1. Introduction

In Ethiopia, faba bean (Vicia faba L.) varieties are important and widely used as a source of food and cash source to large number of subsistence farmers. However, their production and productivity is below the world's average partly because of lack of their sustainable performance in the current scenario of climate change [1]. Faba bean is largely cultivated in the highland areas of the country where population density, land degradation and shortage of farm-land are major concerns. It is one of the cheap sources of protein and crops of food security in Ethiopian diet [1]. Faba bean is an excellent source of protein, vitamins, minerals, fibers and bioactive compounds [1]. Chalew is one of the popular variety adapted to waterlogging vertisol environments of Ethiopia with altitudes ranging from 1900 to 2800 meters above sea level hence the feature demand for it will be high [2]. Storage duration can affect the germination (%) [2]. The storage condition can also affect viability and seedling [3]. Maintaining the quality of seed is dependent on many environmental Factors, some of which are moisture, temperature, humidity, and storage conditions. Even though these factors are properly accounted for, seed quality may still be reduced by certain seed borne diseases or destroyed by insects and other pests. Precursors of volatile compounds are usually present in different forms in faba beans and are carried over into concentrate and isolate following processing and storage [4]. Storage losses can be classified in two categories: direct losses, due to physical loss of commodities; and indirect losses, due to loss in quality and nutrition [3]. Seed dressing

with pesticides is widely used to protect crop seeds from pest insects and fungal diseases [4]. According to [5] there are a lot of fungicide recommended for faba bean seed dressing but utilization is poor. Management strategies for root rot have included fungicide treatments, crop rotation, and variety selection [5]. Pre-sowing seed treatment with systemic fungicides is a firmly entrenched practice for most agricultural crops worldwide [3]. Fungicide seed treatments protect the seed and seedlings from soil-borne diseases, as well as those diseases found on the surface of the seed or carried inside of the seed [6]. This bacterial and fungal disease can be introduced by contaminated seed [7]. There were different dressing chemicals like Apron star a seed treatment fungicide-insecticide mixture for controlling downy mildew, damping-off diseases as well as for protection of seeds and seedlings against early season insect pests and soil borne diseases in beans, sorghum, maize, cotton and vegetables [6]. Several other classes of fungicides, such as triazoles, phenylamides, benzimidazoles and strobilurines, are also used for seed treatment [8]. The widespread use of protectant fungicides such as Chlorothalonil and Mancozeb in grain legumes over the years has resulted in few instances of fungicide resistance in these crops [9]. Disease can be reduced by seed treatments having metalaxyl (Apron XL, Rampart, Mantle/or Medley®) [10].

Most of the time faba bean phase's low germination and weak at early emergence due to different factors. Among these problem insect pests and storage duration are the primary causes. Hence this study was carried out with the following objective.

To determine the impact of seed dressing and storage duration on seed quality parameters of faba bean.

2. Materials and Method

2.1. Description of the Study Area

The study was conducted at Kulumsa Agricultural Research Center (KARC) from March, 2022 to April, 2023 under laboratory conditions. The site is located at 8°00' N and 39°07' E at an elevation of 2210 m above sea level in Arsi Administrative Zone of Oromia Regional State, 167 km South East of Addis Ababa. The agro-climatic condition of the area is wet and receives a unimodal mean annual rainfall of 809.15 mm from March to September; however, the peak season is from July to August. The maximum and minimum mean temperature is 23.08 and 9.9°C, respectively [11].

2.2. Materials

A Chalew Variety of faba bean was treated with different fungicide at recommended rate to see the effect of seed dressing and Storage life on different seed quality parameters of faba bean.

Table 1. *Treatment &Material used for the study.*

Effect of storage duration and seed dressing on seed quality parameters of faba bean	
Factor A: Storage duration (4)	Factor B: Seed dressing Fungicide (6)
Sd1: Month (0)	F0: Chalew with no treatment (control)
Sd2: Month (6)	F1: Chalew treated with Mancozabe 80Wp
Sd3: Month (12)	F2: Chalew treated with Kanzole 25% E.C.
	F3: Chalew treated with proseed plus63WS
	F4: Chalew treated with Apron star 42WS
	F5: Chalew treated with Dynamic 400 FS

2.3. Methods

Faba bean Chalew variety of breeder seed was collected from pulse team of KARC in April 2022. After a proper homogenizing of the seed is maintained and dressed with different fungicide by adjusting the rate of rate of recommendation soon after drying of the treated seed we weight them in three (3) equal working sample from each different fungicide treated seed.

Initial laboratory seed quality test was made by again randomly taken working sample among the three. Sterilized sand at 180°c for 1hr under oven and distilled water was used for germination in in plastic box with cover.

Design and Experimental Layout

A total of 54 plot planted by using RCBD design in factorial arrangement with three replication was used. Different up righted stake having appropriate placing of germinator box was used for blocking and replication. Fifty (50) seed/plastic box was plant. Germination was counted on 14th day of planting and then 10 seed ling from each was taken for measuring shoot and root length of the seedling. Fresh weight of 10 seed ling from each also taken and further dried in oven at 70-105c° for 12 hrs. To measure dry weight of the seedling. Remaining two (2) working sample of treated seed were sealed in air tight small bag and stored in Freeze at 0°c to prevent external humidity and Temperature effect. Again the same laboratory test was made at six (6) month and twelve (12) month to evaluate the effect of storage duration on seed Quality attributes.

2.4. Data Collected

2.4.1. Seed Physical Purity

Seed quality is a function of genetic, physical, physiological and health [8]. Purity is the expressions of how clean the seed lot is. It is calculated as follow according to ISTA 2020.

$$\text{Purity seed (\%)} = \frac{\text{weight of pure seed(g)} * 100}{\text{Total weight of working sample (g)}}$$

Moisture Content (%): Seed moisture content is the most important attribute influencing seed quality and storability.

It was measured soon after cleaning by using Moisture tester adjusted for Faba bean crops.

Thousand seed Weight: is the weight in grams of 1000 seeds

of Faba bean and may indicate grain size and internal composition of seeds. It was taken from working sample after mixing the submitted lot taken from each lot of the same variety and replicated three times for all treatments. Automatic seed counter was adjusted to 1000 and used for counting of the seed.

2.4.2. Seed Germination Data

Germination test allows seed producer to determine and Compare the quality of a seed lot before it is planted. This information can be used to satisfy labeling laws and provide for standardized marketing of seed. The normal germinated seed lings after 14 days of planting was calculated excluding Dead (un germinated seed) and Abnormal seed ling at final count then percentage is calculated as follows.

$$\text{Seed germination (\%)} = \frac{\text{Number of normal seed ling(\#)} * 100}{\text{Total Planted seeds (\#)}}$$

During Germination test only normally germinated seedling was counted as Germinated seed while dead seed (ungerminated) and abnormal seed ling were not included according to ISTA seed germination procedure.

Root and shoot length (cm): At the time of germination count, 10 normal seedlings were taken at random. The length between the collar and tip of the primary root was measured as root length and the mean length expressed in centimeter. From the 10 seedlings used for measuring the root length, the length between collar and tip of the primary shoot was measured as shoot length and the mean value expressed in centimeter.

Seedling Fresh weight: Ten normally germinated seedling was randomly selected from each replication were measured using electrical sensitive balance in mg and the mean was recorded.

Dry weight: Ten normally germinated seedling was randomly selected from each replication soon after weighed for fresh weighed collected in paper bag dried in oven at 70~80c° for 24 hrs. And weighed again for dry weight.

Seedling vigor index (SVI): The vigor level of each treated seed lot was calculated according to as percentage normal emergence multiplied by seedling shoot height and divided by100 while vigor index II was calculated by Seedling Dry Weight × Germination % using the formulas proposed by [12].

VigourIndex-1 = Seedling length × Germination %, and Vigor Index-2 = Seedling Dry Weight × Germination %.

3. Results and Discussion

3.1. Data Analysis

The Collected data were homogenized thoroughly passed for Analysis using Statistix 10.0 Software. Analysis of variance and mean comparison among treatment were also carried out at p (0.05).

Table 2. *Analysis of variance (ANOVA) results.*

Quality parameters	Mean squares for Source of Variation					
	Rep (df=2)	Fungicide (df=5)	Month (df=2)	Fungicide*Month (df=10)	Error (df=34)	Coff. Var. 5%
Moisture content (%)	0.9827	2.4017*	39.2106*	0.6021*	0.525	4.99
Thousand seed weight (mg)	6851.4	2932.36ns	1.9608ns	3.05ns	1238.14	4.43
Hectolitre weight (HLW)	4.6914	10.9781*	4.7236ns	0.0001ns	2.3677	2.2
Germination (%)	23.57	667.75**	1107.35**	34.02*	9.42	3.89
Normal seedling (%)	4.06	688.61**	1305.72**	45.5ns	18.8	21.61
Dead seed (%)	5.13	52.29**	833.18**	42.09**	4.639	41.84
Shoot length (cm)	15.7293	177.49*	2.35ns	0.011ns	1.76346	0.511
Root length (cm)	0.492	124.34**	3.02**	0.001ns	0.305	2.96
Fresh weight (mg)	7.71695	213.02*	0.54*	3.08ns	1.0357	3.88
Dry weight (mg)	0.12952	19.7*	1.95ns	4.62ns	0.03823	60.4003

DF=degree of freedom, Rep=Replications, ns=Non significant variation and * = significant, **=highly significant at p (0.05)

Table 3. *Mean comparison for Different seed Quality parameters of Faba bean.*

Treatments		Moisture content (%)	Thousand seed weight (mg)	Hectoliter weight (HLW)	Germination (%)	A/normal seedling (%)	Dead seed (%)	Shoot length (cm)	Root length (cm)	Fresh weight (mg)	Dry weight (mg)
#	Factor-A (Month)										
1	0	15.216^{a}	795.22^{a}	70.5^{a}	85^{a}	15^{b}	13^{a}	19.15^{a}	19.06^{a}	26.38^{a}	2.57^{a}
2	6	15.523^{a}	794.88^{a}	70^{a}	81.83^{b}	15.27^{b}	1.44^{b}	18.84^{a}	18.76^{b}	26.30^{a}	2.15^{b}
3	12	12.827^{b}	794.56^{a}	69.47^{a}	70.11^{c}	29.88^{a}	1^{b}	18.43^{a}	18.25^{c}	26.05^{a}	1.92^{c}
Alpha		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Standard Error		0.2415	11.729	0.5129	1.0229	1.4453	0.718	0.4427	0.1842	0.3392	0.0652
Critical Value at (5%)		0.4908	23.836	1.0424	2.0788	2.9373	1.4591	0.8996	0.3743	0.6894	0.1325
#	Factor B (Fungicide)										
1	F0	15.333^{a}	810.73^{ab}	68.42^{d}	73^{d}	28.33^{a}	7.11^{ab}	21.93^{b}	21.47^{b}	23.49^{d}	2.38^{b}
2	F1	14.632^{bc}	783.43^{bc}	69.56b^{cd}	80.33^{b}	18.55^{b}	4.22^{c}	17.56^{d}	18.32^{d}	29.03^{b}	2.18^{c}
3	F2	13.97^{c}	770.99^{c}	70.95^{ab}	69.55^{e}	28.44^{a}	7.88^{a}	11.22^{e}	11.96^{e}	23.05^{de}	1.64^{d}
4	F3	14.11^{c}	787.33^{abc}	69.43^{cd}	80.33^{b}	18.11^{b}	4.77^{c}	19.03^{c}	22.64^{a}	24.7^{6c}	2.88^{a}
5	F4	14.854^{ab}	797.2^{abc}	70.096^{abc}	76.33^{c}	22.11^{b}	5.77^{bc}	18.82^{cd}	19.19^{c}	34.88^{a}	2.47^{b}
6	F5	14.222^{bc}	819.65^{a}	71.48^{a}	94.33^{a}	4.77^{c}	1.11^{d}	24.26^{a}	18.55^{d}	22.24^{e}	1.73^{d}
Alpha		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Treatments # Factor-A (Month)	Moisture content (%)	Thousand seed weight (mg)	Hectoliter weight (HLW)	Germination (%)	A/normal seedling (%)	Dead seed (%)	Shoot length (cm)	Root length (cm)	Fresh weight (mg)	Dry weight (mg)
Standard Error	0.3416	16.587	0.7254	1.44	2.044	1.0154	0.626	0.2605	0.4797	0.0922
Critical Value at (5%)	0.6941	33.71	1.4741	2.93	4.1539	2.0635	1.2722	0.5294	0.975	0.1873

Means with the same letters are not statistically significant.

Table 4. *The mean comparison for the combined effect of storage duration and seed dressing fungicide on Seed quality parameters of faba bea.*

#	Factor AB (Fungicide*Month)	Moisture content (%)	Thousand seed weight (mg)	Hectoliter weight (HLW)	Germination (%)	Normal seedling (%)	Dead seed (%)	Shoot length (cm)	Root length (cm)	Fresh weight (mg)	Dry weight (mg)
1	F0 M0	16.33^{a}	811.06^{a}	68.92^{cde}	79.66^{cd}	20.33^{fghi}	18.33^{ab}	22.27^{bcd}	21.85^{bcd}	23.63^{cdef}	2.74^{b}
2	F0 M6	16.33^{a}	810.72^{a}	68.42^{de}	76.66^{de}	21.33^{efgh}	1^{d}	21.96^{cd}	21.54^{cd}	23.54^{cdef}	2.32^{cde}
3	F0 M12	13.33^{ef}	810.4^{a}	67.91^{e}	62.66^{hi}	43.33^{a}	2^{d}	21.55^{de}	21.03^{d}	23.29^{cdef}	2.09^{def}
4	F1 M0	14.74^{cd}	783.77^{a}	70.07^{abcde}	87^{b}	13^{jk}	11^{c}	17.90^{f}	18.7^{efgh}	29.17^{b}	2.54^{bc}
5	F1 M6	15.74^{abc}	783.43^{a}	69.57^{abcde}	84^{bc}	12.66^{jk}	1.6^{d}	17.59^{f}	18.39^{fgh}	29.08^{b}	2.12^{def}
6	F1 M12	13.41^{ef}	783.11^{a}	69.04^{bcde}	70^{fg}	30^{cd}	0^{d}	17.18^{f}	17.88^{h}	28.83^{b}	1.89^{fg}
7	F2 M0	14.97^{bcd}	771.32^{a}	71.46^{abc}	77.33^{df}	22.66^{efg}	20.66^{a}	11.57^{g}	12.33^{i}	23.19^{def}	2^{ef}
8	F2 M6	14.97^{bcd}	770.98^{a}	70.96^{abcd}	72.66^{ef}	25.33^{def}	1^{d}	11.26^{g}	12.03^{i}	23.11^{ef}	1.58^{gh}
9	F2 M12	11.97^{g}	770.66^{a}	70.43^{abcde}	58.66^{i}	37.33^{ab}	2^{d}	10.85^{g}	11.52^{i}	22.86^{f}	1.35^{h}
10	F3 M0	14.83^{cd}	787.67^{a}	69.94^{abcde}	87^{b}	13^{jk}	11^{c}	19.38^{ef}	23.04^{a}	24.9^{c}	3.23^{a}
11	F3 M6	15.01^{bcd}	787.33^{a}	69.44^{abcde}	84^{bc}	13.33^{ijk}	1.33^{d}	19.07^{f}	22.7^{ab}	24.81^{cd}	2.81^{b}
12	F3 M12	12.5^{fg}	787.01^{a}	68.92^{cde}	70^{fg}	28^{cde}	2^{d}	18.66^{f}	22.19^{abc}	24.56^{cde}	2.58^{bc}
13	F4 M0	16.07^{ab}	797.53^{a}	70.6^{abcd}	83^{bc}	17^{ghij}	15^{b}	19.16^{f}	19.52^{e}	35.02^{a}	2.83^{b}
14	F4 M6	15.41^{abcd}	797.19^{a}	70.1^{abcde}	80^{cd}	15.33^{hij}	2.33^{d}	18.85^{f}	19.28^{ef}	34.94^{a}	2.41^{+}
15	F4 M12	13.07^{fg}	796.87^{a}	69.58^{abcde}	66^{gh}	34^{bc}	0^{d}	18.44^{f}	18.77^{efgh}	34.69^{a}	2.18^{def}
16	F5 M0	14.33^{de}	819.99^{a}	71.9^{a}	96^{a}	4^{L}	2^{d}	24.60^{a}	18.92^{efg}	22.38^{f}	2.09^{def}
17	F5 M6	15.66^{abc}	819.65^{a}	71.4^{ab}	93.66^{a}	3.66^{L}	1.33^{d}	24.29^{ab}	18.62^{efgh}	22.30^{f}	1.67^{gh}
18	F5 M12	12.66^{fg}	819.33^{a}	70.95^{abcd}	93.33^{a}	6.66^{kl}	0^{d}	23.88^{abc}	18.11^{gh}	22.05^{f}	1.44^{h}
Alpha		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Standard Error		0.5916	28.73	1.2564	2.5056	3.5403	1.7587	1.0843	0.4512	0.8309	0.1597
Critical Value at (5%)		1.2023	58.387	2.5532	5.092	7.1948	3.5741	2.2035	0.9169	1.6887	0.3245

The mean square of the study revealed that seed dressing had significant difference on seed quality attributes like (MC, HLW, Shoot length, Fresh weight and dry weight of seed ling and highly significant difference on Germination (%) and Root length of the seedling, while it had no significant variation on TSW. The storage duration possessed significant variation on MC and Fresh weight of seedling while showed highly significant variation was observed for Germination (%), and Root length of seedling and no significant variation for other seed quality attributes. Significant variation was observed on MC and seed germination while highly significant differences observed on % dead seeds due use combination of storage duration and fungicide treatment. In agreement with this [3]. The gradual reduction in germination parameter with the increase in storage period was increase.

3.2. Discussion

From the mean comparison table: 3 above the more the storage time increase seed quality attributes decrease. Even though this is inclined with aging factor Chalew treated with Dynamic 400 FS showed significant difference at p (0.05) on seed quality attributes like Germination, shoot length and root length. The highest normally Germinated seed ling was observed by using combination of storage duration and fungicide which was F5:M0, F5:M6, F5:M12 with the value of (96%, 93.66% and 93.33%) respectively.

3.2.1. Root and Shoot Length

The mean comparison results displayed that root and shoot length was significant and highly significantly ($P< 0.05$) affected by seed dressing. The highest root Length (23.04 cm) and shoot length (24.6 cm) were recorded from seeds having treated with F3:M0 whereas the lowest shoot length (10.85cm) was recorded from F2:M12 which might be due to aging factors.

Similarly, the lowest root lengths (11.52 cm and 12.03 cm) were recorded on F2:M12 and F2:M6 Chalew treated with Kanzole 25% E.C respectively. These results agree with the findings of [13] who recorded significantly higher seed quality parameters from onion seeds treated with different colored polymers coupled with fungicide. His result revealed

that seeds coated with polymer yellow+thiram recorded higher root and shoot length.

3.2.2. Fresh and Dry Weight

The highest Fresh weight and dry weight in mg (35.02, 2.83) for seedling was recorded for F4:M0 and the lowest Fresh weight and dry weight in mg (22.05, 1.44) was observed for F5:M12 which might be due to Aging factors.

3.2.3. Seed Vigor I&II Test

Both seedling vigor indices are a measure of seedling growth. Vigor index I considers seedling length, which is quickly measured using a ruler in the laboratory situation. Vigor index II considers seedling mass, which requires that seedlings be weighed after they are dried in an oven. Thus, in most seed laboratories, vigor index I is used more frequently than vigor index II because it is faster. Seed vigor is an important quality parameter which needs to be assessed to supplement germination and viability tests to gain insight into the performance of a seed lot in the field or in storage [14]. According to [12] the decrease in seed vigor determined the level of activity, the performance of seeds during germination, and seedling development. According to Seedling vigor as expressed by seedling length was also affected byaging test condition [15].

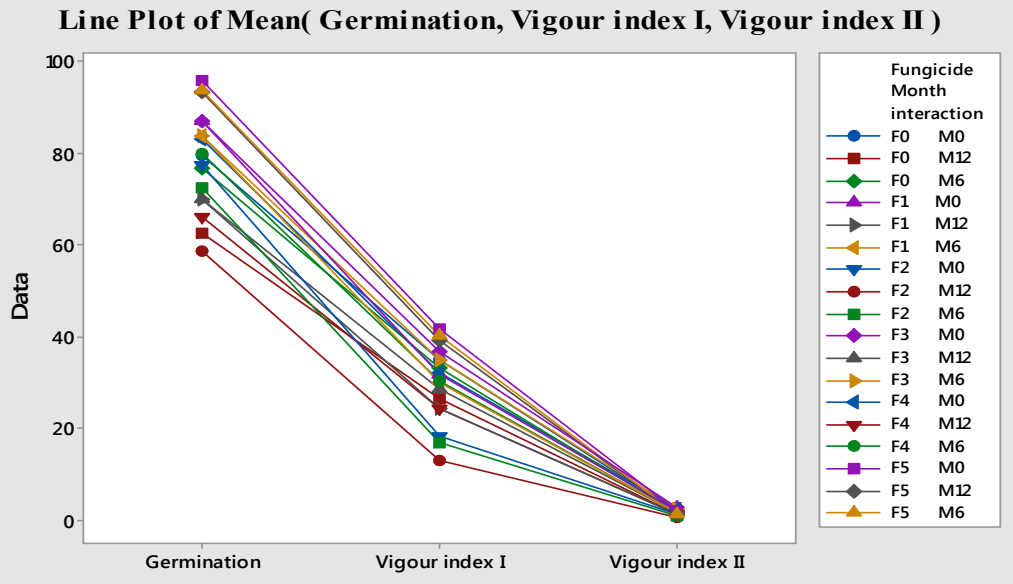

Figure 1. *Effect of seed dressing on Germination (%) and vigor index I&II.*

From figure 1 above vigor index I&II had direct relationship with germination (%) which means increment/decrement in vigor can affect positively germination. The emphases should give to identify why reason root grow toward geotropism and shoot vice versa at that infant stage of seedling.

Figure 2. *Some photos during the work.*

4. Conclusion

In conclusion, results of the present study indicated that Faba bean seed dressing have significant variation on Quality attributes of the seed. Even though aging by itself can affect Quality of the seed different fungicide can make vary the situation. Dynamic 400 FS can sustain the Germination ability and vigor index I&II of the faba bean followed by Mancozabe 80Wp and proseed plus63WS among the fungicide used. To know the detail magnitude of seed quality loses and what factors are involved in long storage duration experiment under controlled events like temperature fluctuation and relative humidity and light intensity will be required.

Conflicts of Interest

The authors declare no conflict of interest.

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