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The Effect of Sowing Windows on Seed Quality and Physical Seed Parameters of *Summer* Soybean

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ABSTRACT: A field experiment was conducted on soybean during *summer* 2022 at PGI-Research Farm, MPKV, Rahuri. Four sowing dates (3rd January, 17th January, 31st January and 14th February) and four varieties (Js-9305, KDS-726, KDS-753, and KDS-992) replicated three times were used in the split plot design of the experiment. The findings showed that, among all the sowing windows, sowing during 3rd MW recorded higher seed quality and physical seed parameters *viz.,* Protein content (40.33 %), oil content (19.71 %), germination percentage (92.81 %), seed moisture content (9.75 %) and seed vigour index-I, II (2416 and 87.81, respectively) over the rest of sowing windows and among, all the soybean varieties, Phule Durva recorded higher seed quality and physical seed parameters *viz.,* Protein content (40.01 %), oil content (19.13 %), germination percentage (92.28 %), seed moisture content (9.77 %) and seed vigour index-I, II (2407 and 87.52, respectively).

Keywords: Seed quality, Germination %, Moisture %, *Summer*, Soybean.

INTRODUCTION

Soybean (*Glycine max* L. Merrill) has become miracle crop of the 21st century and is often designated as 'Golden Bean', "Wonder crop" and 'Poor man's meat'. Soybean belongs to family Fabaceae (Leguminosae). It is the most important economic oilseed crop and recognized as the most popular pulse cum oilseed crop in the world. Quality seed is a major factor in crop development and productivity. Seed quality, as measured by its viability and vigour worldwide, play a major role in crop establishment as well as the final crop yield. Seed deterioration leads to reductions in seed quality, performance and establishment (Donald and Humbblin 1976). Despite the numerous constraints, soybean continues to make improvement in the world economy. Its poor storability remains a great challenge in soybean production worldwide. When compared to other grain crops, soybeans have a shorter germination and vigour potential, which is frequently decreased before planting (Nkang and Umoh 1996). Rapid loss in viability of soybean seed is largely influenced by the genotype of the variety, history of the seed taken to storage, moisture content of seed and temperature and relative humidity of the storage environment (Justice and Bass 1979). It has been long known that the major factors influencing the longevity of seeds in storage are relative humidity and temperature (Barton, 1961). Relative humidity has a greater influence on longevity of seed storage because moisture content is directly related to the atmospheric humidity (Delouche and Baskin 1973). Mainly soybean seed production is being taken up during kharif season. Since for the last few years, incessant rains coincide with pod maturity stage of the crop which results in in-situ germination and rejection of seed lots causes shortage of quality seed. Soybean seed is typically a poorer storer which losses its quality faster rate and leads to poor plant stand in the field. In such situation contingency seed production especially in the off season is very much essential (Navya *et al.,* 2022).

MATERIAL AND METHODS

A field experiment was carried out during *summer* season of the 2022 at Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, M.S. The investigation was carried out to assess the effect of

sowing windows on seed quality and physical seed quality. The experiment was laid out in Split plot design consisting of four sowing windows *viz.,* 1st MW (1st Jan to 7th Jan), 3rd MW (15th Jan to 21st Jan), 5th MW (29th Jan to 4th Feb), and 7th MW (12th Feb to 18th Feb) as main plot and four varieties of soybean *viz.,* JS-9305, Phule Kimaya (KDS-753), Phule Sangam (KDS-726) and Phule Durva (KDS-992) as sub plot and was replicated thrice.

The data pertaining to seed quality and seed physical parameters *viz.,* Protein content (%), oil content (%), germination percentage, seed moisture content (%) and seed vigour index-I, II. In order to record these seed quality and seed physical parameters observations, five plants were randomly selected from each net plot. The selected plants were tagged and labelled using paper tags wrapped inside a transparent polythene cover. All the seed quality and seed physical parameters observations were recorded from these tagged plants. Seed quality and seed physical parameters were recorded from net plot at harvest.

Seed Quality

Protein Content in seed (%). The seed samples from each net plot were collected and used for chemical analysis to determine the protein content. The dried samples of seeds were grind and passed through 20 mesh sieves and about 20 g was taken as representative sample. The sample was stored in plastic bag, properly labelled and used for estimation of protein. The nitrogen percentage in soybean seeds estimated by modified Kjeldahl's method (Jakson, 1973). The protein content was calculated by multiplying the nitrogen percentage with factor 6.25 (Tai and Young, 1974).

Oil Content in seed (%). Oil was estimated by using Soxhlet method (Soxhlet, 1879). The empty weight of the beaker along with four to five boiling stones was taken. Later three gram of ground seed sample was put on thimbles and put these thimbles with basket in to the beaker. The beaker was filled with 100 ml of 60-75 per cent petroleum ether and kept in soxtherm. The soxtherm is a computer-based programme and set the air pressure at five bars after turning on the tap water. The system was programmed for 3 h 25 min. After completion the beaker was kept in hot air oven for 30 min (103°C or 105°C). Later the beaker was kept immediately in desiccators for 30 min and took the weight of the beaker. The oil content was measured by using the following formula.

$$\text{Oil content (\%)} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Weight of sample (g)}} \times 100$$

Germination (%). Germination test was conducted in three replications of 100 seeds each by adopting between paper method as described by ISTA rules Anon., (2011c). The temperature of 25 ± 1^{0}C and RH of 95 per cent was maintained during the germination test. The number of normal seedlings were counted at the end of 8 days of germination and expressed in percentage.

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

Seed moisture. Five randomly selected plants from each replication of each plot were tagged before physiological maturity. The selected plants were cut off from ground level. Seeds from pod were removed and subjected to moisture determination following hot air oven method on wet weight basis (Singh and Gupta 1982) as follows.

$$\text{Seed moisture (\%)} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,

W_1 = Fresh weight of seed sample (g)

W_2 = Dry weight of seed sample (g)

Seed Vigour index. It is highly complex procedure. At the level of seed germinate, it involves speed and totally of germination, pushing power of the seedling, range of stress conditions under which germination occurs. Therefore, seed vigour from seed testing stand point is the sum total of all seed attributes favour stand establishment under varying field conditions. A vigour test is not a test for field response purpose. Vigour is usually defined as that condition of the active good health and robustness in seed which upon planting permits germination to proceed rapidly under a wide range of environmental or field conditions. It can be estimated by accelerated ageing and conductivity test. At the end of germination test, ten normal seedlings from each replication were selected for calculation of vigour index (Abdul- Baki and Anderson, 1973) and was calculated as under .

Seed vigour-I = Germination (%) × Mean seedling length (cm)

Seed vigour-II = Germination (%) × Mean seedling dry weight (g)

RESULTS AND DISCUSSION

Seed Quality. The protein and oil content (%) was found non-significant among the sowing windows as well as varieties. However, the maximum protein and oil percent was noted in 3rd MW sowing (40.33 % and 19.71%, respectively). The percent protein in seed is partly a function of accumulation of nitrogen in seeds wherein the increase in nitrogen uptake during early sowing of *summer* soybean is due to efficient translocation of photosynthates that might have increased the protein content. Similar results were also reported by Ram *et al.* (2010); Kundu *et al.* (2016); Nawale *et al.* (2018). However, the maximum protein and oil percent was noticed in variety Phule Durva (40.01 % and 19.13 %) followed by Phule Sangam (39.06 % and 18.90%) and Phule Kimaya (39.04 % and 18.81%) respectively. Phule Durva had high protein and oil content which might be due to genetic behaviour of the variety. Similar results were also reported by Nawale *et al.* (2018).

Table 1: Protein and oil content (%) in seed of *summer* soybean as influenced by different treatments.

Treatments		Protein content (%)	Oil content (%)
A.	**Main plot: Sowing windows (S)**		
S_1 :	1st MW (1st Jan.-7th Jan.)	39.05	18.92
S_2 :	3rd MW (15th Jan.-21st Jan.)	40.33	19.71
S_3 :	5th MW (29th Jan.-04th Feb.)	38.42	18.64
S_4 :	7th MW (12th Feb.-18th Feb.)	38.37	18.10
	S.Em. ±	0.5	0.3
	C.D. at 5 %	NS	NS
B.	**Sub plot: Varieties (V)**		
V_1 :	JS-9305	38.06	18.53
V_2 :	Phule Kimaya	39.04	18.81
V_3 :	Phule Sangam	39.06	18.90
V_4 :	Phule Durva	40.01	19.13
	S.Em. ±	1.1	0.5
	C.D. at 5 %	NS	NS
C.	**Interaction (S × V)**		
	S.Em. ±	2.3	1.1
	C.D. at 5%	NS	NS
	CV %	10.2	10.5
	General Mean	39.04	18.84

Physical seed quality. The seed germination (%), seed moisture (%) and seed vigour index-I, II of *summer* soybean was found non-significant among the sowing windows and varieties. The highest seed germination (%), seed moisture (%), seed vigour index-I and seed vigour index-II (92.81 %, 9.75 %, 2416 and 87.81, respectively) was recorded with sowing of *summer* soybean during 3rd MW sowing. This might be due to steady accumulation growing Degree Days (GDDs), temperature, moisture content of seed, early maturity in early sowings. Similar results were also reported by Rahman *et al.* (2013); Kundu *et al.* (2016); Bhatia and Jumrani (2018). The variety Phule Durva registered highest seed germination (%), seed moisture (%), seed vigour index-I and seed vigour index-II (92.28 %, 9.77 %, 2407 and 87.52, respectively). This may be caused by the genetic makeup of the variety, the size, thickness, and moisture content of the seeds as well as storage conditions. Similar results were also reported by Hu and Wiatrak (2012); Bhatia and Jumrani (2018); Navya *et al*. (2022); Raut *et al.* (2023).

Table 2: Physical seed quality studies of *summer* soybean as influenced by different treatments.

Treatments		Germination (%)	Seed moisture content (%)	Seed vigour index-I	Seed vigour index-II
A.	**Main plot: Sowing windows (S)**				
S_1 :	1st MW (1st Jan.-7th Jan.)	91.75	9.71	2390	86.40
S_2 :	3rd MW (15th Jan.-21st Jan.)	92.81	9.75	2416	87.81
S_3 :	5th MW (29th Jan.-04th Feb.)	91.30	9.66	2365	86.21
S_4 :	7th MW (12th Feb.-18th Feb.)	90.57	9.52	2331	85.78
	S.Em. ±	0.68	0.13	50	1.8
	C.D. at 5%	NS	NS	NS	NS
B.	**Sub plot: Varieties (V)**				
V_1 :	JS-9305	90.94	9.71	2372	86.37
V_2 :	Phule Kimaya	91.37	9.59	2359	86.08
V_3 :	Phule Sangam	91.84	9.56	2363	86.23
V_4 :	Phule Durva	92.28	9.77	2407	87.52
	S.Em. ±	2.2	0.26	65	2.4
	C.D. at 5%	NS	NS	NS	NS
C.	**Interaction (S × V)**				
	S.Em. ±	4.5	0.52	130	4.9
	C.D. at 5%	NS	NS	NS	NS
	CV %	8.5	9.4	9.5	9.9
	General Mean	91.87	9.66	2375	86.55

CONCLUSIONS

The study revealed that among the sowing windows *summer* soybean crop sown on 17th January (3rd MW) was found to be superior with respect to seed quality and physical seed quality. Based on the study, it can be adjudged that the soybean variety Phule Durva (KDS-992) was most promising variety with respect to seed quality and physical seed quality.

FUTURE SCOPE

The unfavorable meteorological conditions, in particular the temperature, rainfall, and higher humidity, make crops more vulnerable to the

occurrence of insects and diseases, which lowers the quality of seed production during the kharif season. This unfavorable environmental factor affects the production of Kharif soybeans in two ways: it reduces germination percentage and yield. As a result, one of the biggest challenges for farmers is the production of seeds and the supply of high-quality soybean seeds. To get beyond this obstacle, we need to produce high-quality soybean seeds in the summer to meet the demand for kharif soybean seeds. Therefore, to acquire the best yield of summer soybean and enhance the supply of seeds for planting in the kharif season, it is vital to determine an appropriate date for sowing of different varieties in the summer season.

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Conflict of Interest. None.

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