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Original Research Article

Crop Physiological Maturity: A Proper Stage to Harvest Soybean Crop

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Keywords

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A B S T R A C T

The experimental results revealed that seed moisture at harvest, hundred seed weight, seed size, per cent seed germination, root length, shoot length, vigour index, seedling weight, seedling dry weight and seed yield differed significantly due to genotypes and harvesting stages. Seed moisture content, hundred seed weight, seed size, germination, root length, shoot length, vigour index, seedling weight, seedling dry weight and seed yield were maximum at physiological maturity stage. Among the genotypes studied, AMS-353 was found to be best genotype for seed/crop production as the seeds of this genotype have good germ inability, high vigour index, protein content, oil content and seed yield. All seed and seedling vigour components has attained maximum values at physiological maturity stage and decreased at subsequent stages of harvesting after physiological maturity. Hence, it is advisable to harvest the soybean crop at physiological maturity stage.

Introduction

Seed is a carrier of the genetic potential for higher crop production. Quality seed forms the foundation of successful agriculture for sustained growth. The extent of success in agriculture as such is directly governed by quality and quantity of seed.

Soybean (*Glycine max* (L.) Merrill) being legume crop, fixes atmospheric nitrogen and improves the soil fertility. It is a unique crop of versatile nutritional attribute, yielding both oil and protein. It is truly a "Wonder crop" as its vast multiplicity uses as food, fodder, industrial products and residues in soil and also accounting for nearly 50 per cent of total oilseed acreage as well as production.

It was considered only as a food and fodder crop till Second World War when its potential as an oilseed crop was realized by leaps and found as an oilseed crop. On the global scales, it ranks on the top of the list of oilseed crops and contributes over one third of the total supply of the world vegetable oil pool.

The productivity of soybean in India is lower due to the constrains like lack of location specific varieties, lack of diseases and pest resistant and drought tolerant varieties, lack of long shelf life of soybean oil and good seed and high yielding varieties. Therefore, to increase the production of soybean in India to the world levels becomes a challenge to soybean breeders today.

Expansion of soybean cultivation depends upon availability of quality seed. Timely sowing, recommended fertilizer dose, optimum seed rate, better plant protection as well as timely harvesting and good storage are the key factors for getting better yield and quality of soybean.

In general, environment plays an important role in production of quality seed. Among the various factors seed size may influence on rate of germination. Environmental factors, such as temperature and humidity have great importance in production of quality soybean seed.

To maintain maximum vigour and viability of seed and to avoid losses at the time of harvest, harvesting of soybean crop at proper maturity stage is important. If the soybean is harvested at physiological maturity, it can result in seed quality being at its peak and further deterioration could be reduced. The stage of physiological maturity denotes peak seed vigour and viability (Thomson, 1979). Indication of physiological maturity could lead to a stage where seed can be harvested and stored for longer period. Delayed harvesting rather than delayed sowing date is responsible for low seed quality. Keeping these points in view the research work was planned.

Materials and Methods

A present investigation using treatments consisting five genotypes viz., AMS-353, NRC-37, JS 93-05, MAUS-71, JS-335 with three harvesting stages *viz*., harvesting at physiological maturity (H_1), five days after physiological maturity (H_2) and at field maturity (H_3) in FRBD was conducted during *kharif* season of 2015-2016 at experimental field of Department of Agricultural Botany, Dr. PDKV, Akola. Thus there were total 15 treatments viz., G_1H_1, G_1H_2, G_1H_3, G_2H_1, G_2H_2, G_2H_3, G_3H_1, G_3H_2, G_3H_3, G_4H_1, G_4H_2, G_4H_3, G_5H_1, G_5H_2 and G_5H_3 formed. Observations were recorded on five randomly selected plants from each replication on eleven parameters *viz.*, seed moisture at harvest (%), hundred seed weight (g), seed germination (%), seedling vigour, root length (cm), shoot length (cm), seedling weight (g/five seedlings), seedling dry weight (g/five seedlings), vigour index, seed size (ml/100 seeds), seed yield/plant (g).

Results and Discussion

The analysis of variance revealed the presence of substantial amount of variation among treatments for all the characters studied. Similar findings were also reported by Nangju (1977), Gbikpi and Crookston (1981) and Sidibe*et al.*, (1999).Significantly higher seed moisture was noted in genotype AMS-353 (21.61 %) than all other genotypes and followed by genotype JS 93-05 (20.52 %). The genotype JS-335 was found to be at par with NRC-37 and MAUS-71).

Significantly higher hundred seed weight was noted in genotype JS 93-05 (12.97 g). The genotype AMS-353 (10.57 g) was at par with JS-335 (10.33 g) and NRC-37 (11.39 g) was at par with MAUS-71 (11.27 g). Results for seed size indicated that genotype JS 93-05 produced bold sized seeds. AMS-353, NRC-37 and JS-335 produced medium sized seeds whereas; MAUS-71 produced small sized seeds. For different stages of maturity, highest seed moisture per cent at harvest was recorded at physiological maturity (28.02 %) while lower seed moisture in soybean seed (14.72 %) was observed at field maturity stage.

Higher seed weight was recorded at physiological maturity (12.23 g), while lower seed weight (10.52 g) was observed at field maturity stage in soybean seed.

Table.1 Seed characters as influenced by genotype x stage of harvest

Characters	Seed moisture at harvest (%)	Hundred seed weight (g)	Seed size (ml/100 seeds)
Genotypes (G)			
AMS-353	21.61(27.7)	10.57	9.66
NRC-37	18.83(25.7)	11.39	9.33
JS 93-05	20.52(26.9)	12.97	11.66
MAUS-71	19.00(25.8)	11.27	8.33
JS-335	19.04(25.9)	10.33	9.33
SE±	0.22	0.08	0.15
CD (P = 0.05)	0.64	0.24	0.45
Stages of harvest (H)			
Physiological maturity (PM)	28.02(31.9)	12.23	10.00
5 days after PM	16.66(24.1)	11.67	9.66
Field maturity	14.72(22.6)	10.52	9.33
SE±	0.17	0.06	0.12
CD (P = 0.05)	0.50	0.18	0.35
Interaction (G x H)			
SE±	0.38	0.14	0.27
CD (P = 0.05)	1.12	0.41	NS

(Figures in parentheses are arc sine transformed); NS- Non-significant.

Table.2 Seed moisture at harvest (%) as influenced by genotype x stage of harvest

Genotypes	Stages of harvest		
	Physiological maturity (PM)	5 days after PM	Field maturity
AMS-353	29.90(33.1)	18.84(25.7)	16.00(23.6)
NRC-37	26.00(30.7)	16.40(23.9)	14.10(22.1)
JS 93-05	28.23(32.1)	18.20(25.3)	15.13(22.9)
MAUS-71	27.90(31.9)	15.23(23.0)	13.86(21.9)
JS-335	28.00(31.9)	14.63(22.5)	14.50(22.4)
SE±	0.38		
CD (P=0.05)	1.12		

(Figures in parentheses are arc sine transformed)

Table.3 Hundred seed weight (g) as influenced by genotype x stage of harvest

Genotypes	Stages of harvest		
	Physiological maturity (PM)	5 days after PM	Field maturity
AMS-353	11.6	10.4	9.7
NRC-37	12.1	11.4	10.6
JS-9305	14.2	12.6	12.1
MAUS-71	11.6	11.3	10.9
JS-335	11.6	10.1	9.3
SE±	0.14		
CD (P=0.05)	0.41		

Table.4 Seed germination, seedling vigour components and seed yield as influenced by genotype x stage of harvest

Characters	Seed germination (%)	Root length (cm)	Shoot length (cm)	Vigour index	Seedling weight g/five seedlings	Seedling dry weight g/five seedlings	Seed yield/ plant (g)
Genotypes (G)							
AMS-353	86.00(9.27)	13.82	13.20	2331.2	4.16	0.36	18.23
NRC-37	72.33(8.50)	13.84	13.13	1957.3	3.66	0.38	16.80
JS 93-05	80.66(8.98)	13.75	13.80	2225.3	3.93	0.36	16.16
MAUS-71	80.00(8.94)	12.90	12.43	2036.1	3.96	0.35	14.56
JS-335	79.33(8.91)	13.80	13.20	2145.0	4.14	0.41	13.96
SE±	0.06	0.11	0.12	29.08	0.07	0.006	0.41
CD(P=0.05)	0.19	0.32	0.35	84.23	0.22	0.018	1.21
Stages of harvest (H)							
Physiological maturity (PM)	86.60(9.30)	14.43	13.77	2440.7	4.12	0.41	16.58
5 days after PM	80.00(8.94)	13.56	13.08	2131.0	3.96	0.37	16.06
Field maturity	72.40(8.51)	12.88	12.60	1845.0	3.84	0.34	15.20
SE±	0.05	0.08	0.09	22.53	0.06	0.005	0.32
CD(P=0.05)	0.15	0.25	0.27	65.25	0.18	0.015	0.94
Interaction (G x H)							
SE±	0.11	0.19	0.21	50.37	0.13	0.01	0.72
CD(P=0.05)	NS	NS	0.61	145.89	NS	0.03	NS

(Figures in parentheses are square root transformed), NS- Non-significant

Table.5 Vigour index as influenced by genotype x stage of harvest

Genotypes	Stages of harvest		
	Physiological maturity (PM)	5 days after PM	Field maturity
AMS-353	2617	2440	1937
NRC-37	2306	1866	1700
JS 93-05	2438	2273	1965
MAUS-71	2390	2019	1698
JS-335	2453	2058	1924
SE ±	50.37		
CD (P=0.05)	145.89		

Seed size was not differing much due to harvesting of soybean at different maturity stages.

Genotype x stage of harvest interaction revealed maximum seed moisture at harvest was observed in AMS-353 (29.90 %), when harvested at physiological maturity and decreased significantly at subsequent stages of harvest. In all the genotypes the seed moisture at harvest was high at physiological maturity and decreased significantly at subsequent stages of harvest.

Data on hundred seed weight as influenced by genotype x stage of harvest interaction are presented in Table 3.Genotype x stage of harvest interaction revealed that, the highest hundred seed weight (14.2 g) was observed in JS 93-05, when harvested at physiological maturity and decreased significantly at five days after physiological maturity and field maturity stage of harvest. In all the genotypes the hundred seed weight decreased significantly at subsequent stages of harvest. Data on seed size as influenced by genotype x stage of harvest was found to be non-significant.

Data on seedling vigour components and seed yield as influenced by genotype x stage of harvest is presented in Table 4. The analysis of variance revealed that the per cent seed germination, root length, shoot length and vigour index differed significantly due to genotype.

Data presented in Table 4 indicates that maximum seed germination (86 %) was observed in AMS-353 and it was significantly superior over all other genotypes. JS 93-05 (80.66 per cent) was second best genotype in respect of per cent germination. In general the performance of seed germination was better in all the genotypes.

Significantly higher vigour index was observed in AMS-353 as compared to all other genotypes. Genotype JS 93-05 was found at par with JS-335 and MAUS-71 was at par with NRC-37.

Significantly highest seed yield per plant was observed in AMS-353 (18.23 g) whereas, lowest seed yield per plant was observed in JS-335 (13.96 g). The genotype NRC-37 (16.80 g) was at par with JS 93-05 (16.16 g) and MAUS-71 (14.56 g) was at par with JS-335 (13.96 g).

Harvesting of soybean at physiological maturity significantly increased the per cent seed germination up to 86.60 per cent than harvesting at field maturity stage (72.40%). Harvesting of soybean five days after physiological maturity also performed well (80 %) in respect of germination.

Significant differences were observed for vigour index values due to harvesting of crop at different stages *viz*., physiological maturity (2440.7), five days after physiological maturity (2131), at field maturity (1845). Harvesting of soybean at physiological maturity significantly increases vigour index as compared to later stages of harvest.

Harvesting of soybean at physiological maturity shows significantly increased seed yield per plant (16.58 g) as compared to field maturity stage (15.20 g).

Data on interaction between genotype x stage harvest in respect of vigour index is presented in Table 5. The data revealed that interaction effect for vigour index was significant. It is found that significantly higher vigour index was observed in AMS-353 (2617) over all the remaining genotypes when harvested at physiological maturity. The higher vigour index have been observed in allthe genotypes when harvested at physiological maturity and decreased significantly at subsequent stages of harvest. This may be due to germination capacity and vigour index reached its maximum values at physiological maturity stage and the cells of cotyledons were filled with starch, lipid granules and protein globules. It was further observed that the seed germination, vigour index, seedling weight, seedling dry weight and seed yield were significantly reduced with advancement of different stages of harvest after physiological maturity.

This may be due to deterioration of seed because of field weathering and pod shattering after physiological maturity. Similar results were also obtained by Severo and Lin (1982), Carraro *et al.,* (1983), Mugnisjah and Nakamura (1984) and Tyagi (1992).

Results obtained from present investigation revealed that, among the genotypes studied, AMS-353 was found to be best genotype for seed/crop production, as the seeds of this genotype have good germinability, high vigour index and seed yield and should be exploited for further improvement in the crop.

The seed germination, seed vigour components and seed quality found to be better when the soybean crop was harvested at physiological maturity than the crop harvested at five days after maturity and at field maturity. All seed and seedling vigour components has attained maximum values at physiological maturity stage and decreased at subsequent stages of harvesting after physiological maturity. Hence, it is advisable to harvest the soybean crop at physiological maturity stage.

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