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Study of soybean genotypes to determine the extent of genotypic variation in linear rate of seed growth and yield

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Abstract
Selection of suitable genotype for growth and yield is of prime concern for soybean growers. Moreover, identification of suitable plant traits showing maximum contribution to final seed yield is important for plant architects. To find out the variation in seed growth rate and yield performance among seven soybean genotypes, a field study was conducted for soybean varieties viz., G1=MAUS-162, G2=MAUS-158, G3= JS-93-05, G4=MAUS-612,G5=JS-335,G6= MAUS-81, and G7=MAUS-71. Experiment was laid out in randomized block design (RBD) with three replications. All these varieties were at full bloom stage during 38 to 43 DAS, matured during 93 to 105DAS, pod length varied from 3.52cm to 3.91cm, pod diameter varied from 0.67cm to 0.83cm. At harvest stage. Number of pods per plant, number of seed per pod were ranged from 74.47 to 92.36 and 2.53 to 3.46 respectively among the genotypes. Soybean genotype MAUS-158 showed best performance as it recorded higher seed yield (1125.00 kg ha-1), followed by MAUS-71 and MAUS-162.

Keywords: Soybean, varieties, seed yield, plant traits

Introduction
Soybean is (*Glycine max* (L.) Merrill] one of nature's most versatile crop, is increasingly becoming an important food and cash crop in the tropics due to its high nutrient quality and adaptability to various growing environments (Mc Kevith, 2005) [5]. It is the most important *kharif* oilseed crop of Maharashtra. Area under soybean during 2017-18 was 101.56 lakh ha with production of 83.50 lakh MT besides productivity of 822 kg per ha in India. While in Maharashtra area under soybean was 34.84 lakh ha with production of 29 lakh MT besides productivity of 841 kg per ha. (SOPA 2017-18).
Being a rich source of protein and oil, it is referred to as vegetarian meat and can substitute egg, meat or cod-liver oil. The soybean is widely used in the preparation of various food products which ranged from milk to biscuits, cakes, sweets and other confectionery production. The soya milk prepared form soybean is equally nutritious as that of cow and sheep and oil cakes are very nourishing feed for the livestock and poultry. Soybean oil is used for manufacturing vanaspati ghee and several other industrial products. It is widely used in the industrial production of different antibiotics. Soybean, being the richest, cheapest and easiest source of the best multiplicity of uses as food and industrial products the future demand for soybean will increase and the soybean yield must be improved to meet this demand (Aninsworth *et al*., 2012) and hence called a "wonder crop".

Material and Methods
The present investigation was undertaken "To determine the extent of genotypic variation in linear rate of seed growth and yield." at experimental farm of Dept. of Agril. Botany, VNMKV, Parbhani during *kharif* 2017.for evaluation of variation for number of nodes, days to 50 % flower, number of pods per node, number of pods per plant, length of pod, diameter of pod, number of seeds per pod along with seed yield per plant among the genotypes, the seven varieties Viz., MAUS-158, MAUS-162, MAUS-81, MAUS-71, MAUS-612, JS-335 and JS-93-05 were sown with plant spacing used in 45x15 cm. The data were recorded on five randomly selected competitive plants in each replication and each genotype for all above mentioned parameters. To evaluate the linear pattern of seed growth rate, pods were selected from field plant at 65,75and 85 DAS. The observations viz., pod length, diameter of pod, weight of pod wall and increasing weight of developing seed were completed from the same pods at 10 days interval period. At harvest the observations were completed for biomass and seed yield from selected plants.
the was analyzed by statistical method used by Panse and Sukhatme. (1961).

Result and Discussion

a) Days to 50% flowering

The data depicted in graph No.1 from the present study revealed that the days required for 50% flowering were ranged from 38.00 to 43.00. Among the genotypes, JS-335 required significantly lesser days (38.00 days) for attainment of 50% flowering while MAUS-162 required significantly maximum days (43.00 days) for 50% flowering.

Days required for flowering is a genetic character and it depends on photoperiod. Therefore the variation occured among the varieties. Genotypic variation for 50% flowering among soybean genotypes were also reported by Vasht D. (2016) [4].

b) Days to physiological maturity

The data depicted in graph No.2 from the present study revealed that the days required for physiological maturity ranged from 93.00to 105.00. Among the genotypes, JS93-05 (94.00) and JS-335 (93.00) showed significantly early physiological maturity and at par with MAUS-612 (95.00) and MAUS-81 (96.00). Genotype MAUS-162 (105.00) & MAUS-71 (98.00) noted significantly maximum time was required for physiological maturity.

The physiological maturity is the stage at which the seeds gain their maximum dry weight (Harrington, 1972). Genotypic variation for physiological maturity among soybean genotypes were also reported by Vasht D. (2016) [4].

c) Pod length (cm)

The Present study showed that the length of pod of soybean genotype recorded at different crop growth stages are presented in Graph 3. At 65 DAS pod length varied from 1.26 to 1.39 (cm) while at 75 DAS it was ranged from 2.43 to 2.60 (cm) and at 85 DAS 3.53 to 3.91 respectively. Among the genotypes, MAUS-158 (3.91) and JS-93-05 (3.76) showed maximum pod length and minimum in JS-335 (3.52) at harvest time.

There was a considerable variation in pod length among soybean genotypes under investigations. Highest pod length which may be attributed to genetic behavior of the genotypes the similar study also concluded by Vash D., (2016) [4].

d) Diameter of pod (cm)

The data depicted in graph No.4 showed that the diameter of pod of soybean genotype recorded at different crop growth stages are presented in Graph 4. At 65 DAS pod length varied from 0.35 to 0.39 (cm) while at 75 DAS it was ranged from 0.54 to 0.69 (cm) and at 85 DAS 0.67 to 0.83 respectively. Among the genotypes, MAUS-162 (0.83) and MAUS-612 (0.82) showed maximum pod diameter and minimum in MAUS-158 (0.67) at harvest time.

The pod diameter and girth provides the space for seeds for its development and expansion which may be beneficial in terms of seeds size. The results are in confirmatory with Ratan Baghale., (2012) [2].

e) Developing seed weight (gm)/pod

The Present study showed that the developing seed weight of soybean genotype recorded at different crop growth stages are presented in Graph No.5. The results revealed that developing seed weight was not significantly (at 5%) influenced at 65 & 75 DAS however it was significant at 85 DAS but observed a linear increase in developing seed from 65DAS, 75DAS and 85 DAS. At 65 DAS developing seed weight varied from 0.10 to 0.18 gm per pod while at 75 DAS it was ranged from 0.22 to 0.26 and at 85 DAS 0.52 to 0.72 respectively. At harvest the developing seed weight was maximum in soybean genotype MAUS-158 (0.72) followed by MAUS-71 (0.65) and it was minimum in MAUS-612 (0.52)

The similar study also concluded by Vasht D., (2016) [4]. He showed that the genotype obtained significantly maximum pod weight JS21-03 (7.45) gram per plant followed by genotypes JS21-06 (7.39) and JS21-08 (7.16).

f) Weight of Pod wall (gm)

The Present study showed that the weight of pod wall of soybean genotype recorded at different crop growth stages are presented in Graph No.6. The results revealed weight of pod wall was significant (at 5%) among various genotypes at 65 DAS, 85 DAS and non-significant at 75 DAS but observed a linear increase in weight of pod wall from 65DAS, 75DAS and 85 DAS. At harvest the weight of pod wall was maximum in soybean genotype MAUS-158 (0.17) followed by MAUS-612 (0.15), MAUS-162 (0.15) and it was minimum in MAUS-812(0.11).

Soghani *et al.* (2014) reported that the interaction effect of irrigation on pods dry weight was significant.

g) Number of pods/plant

The data depicted in graph No.7 showed that the number of pods per plant ranged from 74.47 to 92.36. Genotypes MAUS-158 (92.36) exhibited significantly maximum number of pods per plant followed by genotypes MAUS-71 (87.89) and MAUS-162 (83.31) than rest of the genotypes. However, the minimum number of pods per plant was recorded in JS-335 (74.47).

Number of pods per plant are the important yield contributing attributes. The results are in confirmatory with. Ratan Baghale., (2012) [2].

h) Pods per node

The results showed that the pods per plant ranged from 3.97 to 6.08. Genotype MAUS-158 (6.08) had significantly higher number of pods per node at par with MAUS-162 (5.74) and MAUS-71 (5.34). However, genotype JS-335 (3.97) noted minimum pods per node.

These results are consistent with the study of Barskar *et al*., (2014) [3], the perusal of the data revealed that higher PCV and GCV were recorded for number of clusters per plant followed by seed yield per plant, biological yield per plant, number of pods per plant and plant height.

i) Number of seeds/pod

The data depicted in graph No.9 showed that the number of seeds per pod ranged from 2.92 to 3.46. Genotype JS93-05 (3.46) exhibited maximum number of seeds per pod and was at par with MAUS-162 (2.86), MAUS-158 (2.93), MAUS-612 (2.92) and significantly superior over rest of the genotypes.

There is considerable evidence that the seed yield is a function of seed number produced (Chase, 1971). These result also supported by the study of Adasul D.L., (2013) [1].

j) Seed Yield (g/plant)

Seed yield per plant is the final expression of physiological and Metabolic activities of a plant and a product of cumulative action of all factors contributing to better growth viz. number of pods / plant, no. of seeds /pod number of branches per plant and seed index. The data depicted in graph No. 10 showed that the seed yield per plant ranged from 8.90

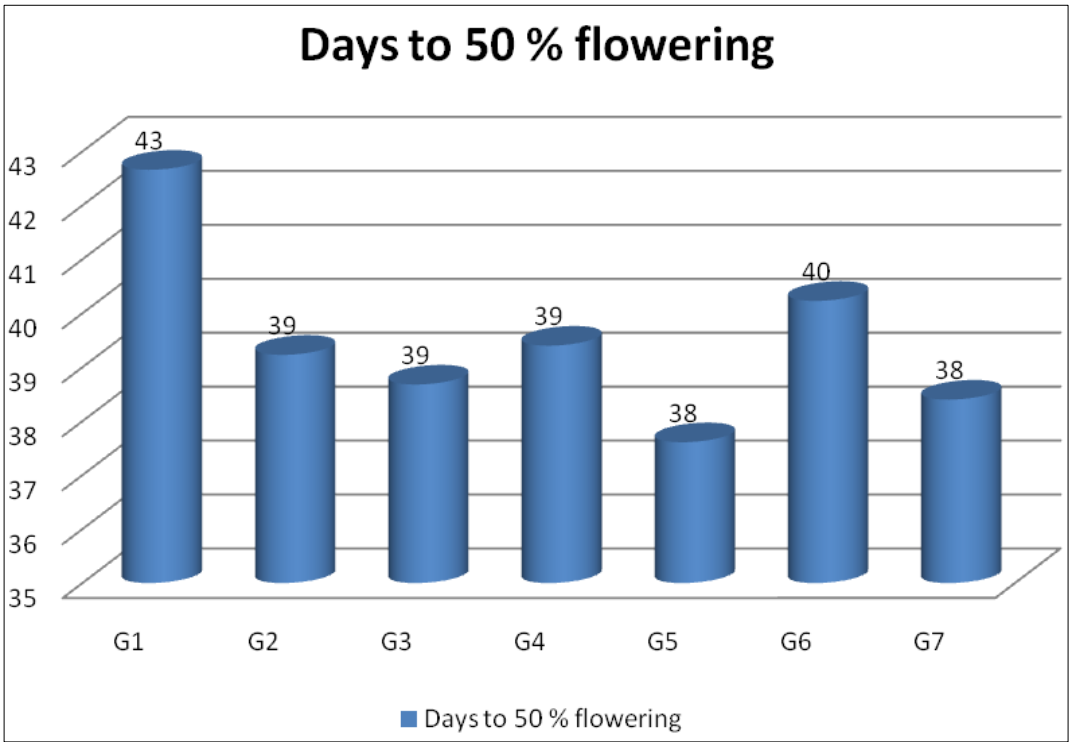
to 14.12 gm per plant. Genotype MAUS-158 (14.12) significantly superseded rest of the genotypes for seed yield per plant and was at par with MAUS-71 (13.18), MAUS-162 (12.50) and MAUS-612 (12.21). Lowest seed yield was recorded in genotype JS-335 (8.90).

These results are consistent with the study of Adasul D.L., (2013) [1] showed that the genotype EC-32626 recorded highest yield per plant (9.40 g) while the genotype KDS-708 recorded lowest yield per plant (4.37 g) which is at par with genotype KDS-699 (4.46 g).

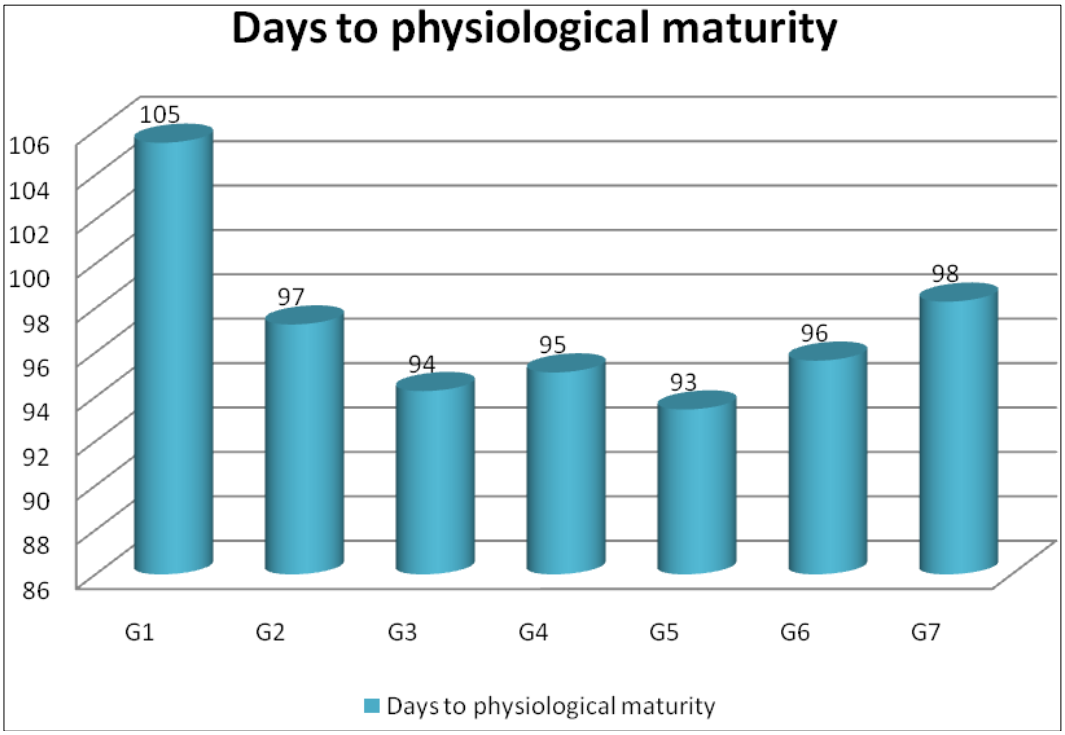
k) Seed yield (kg per ha)

The data depicted in graph No. 11 showed that the seed yield per hectare ranged from 637.03 to 1125.00 kg per ha. Genotype MAUS-158 recorded highest seed yield (1125.0 Kg per ha) followed by MAUS-71 (1057.80 kg per ha) and MAUS162 (1029.2 kg per ha). Lowest seed yield was recorded by JS-335 (637.04 kg per ha).

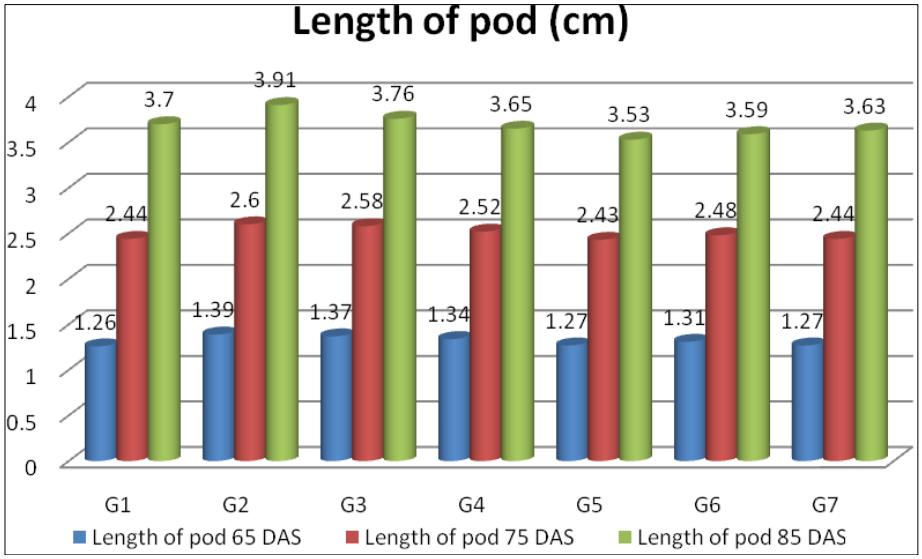
These results are consistent with the study of Adasul D.L., (2013) [1] showed that the genotype EC-32626 produced significantly the highest mean grain yield (31.34q/ha) among all the genotypes. The genotype KDS-699 produced significantly the lowest mean grain yield (14.28 q/ha).



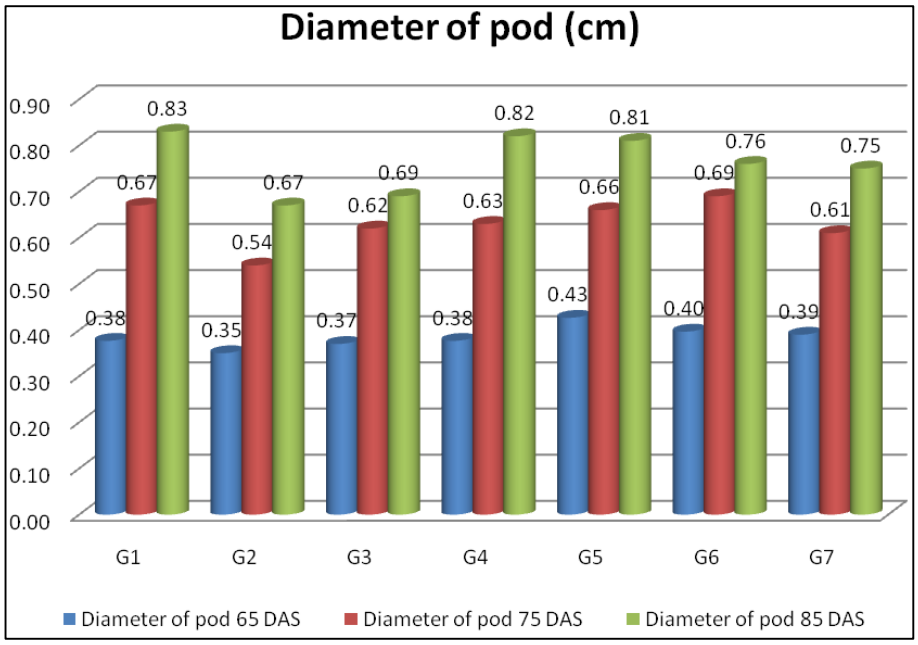
Graph 1: Variation in days to 50% flowering in soybean genotypes



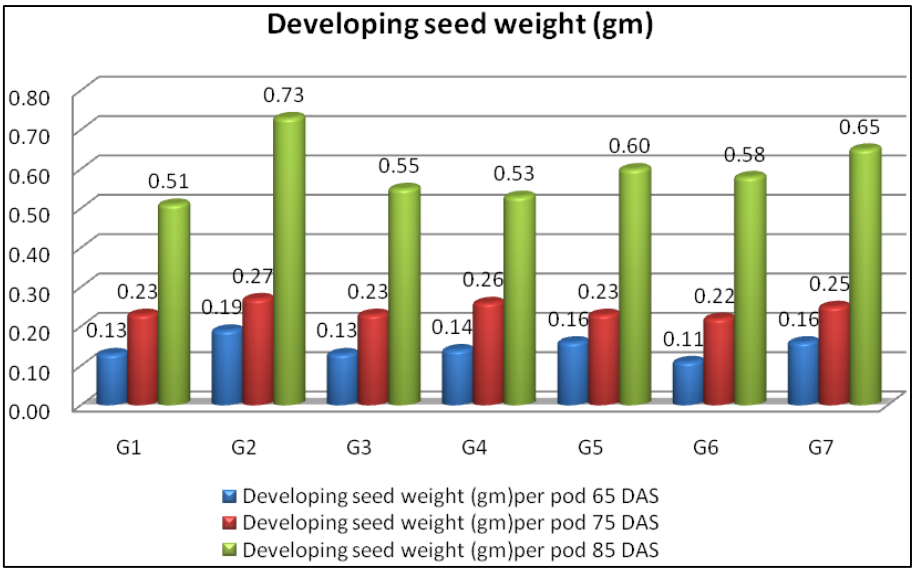
Graph 2: Variation in days to physiological maturity in soybean genotypes



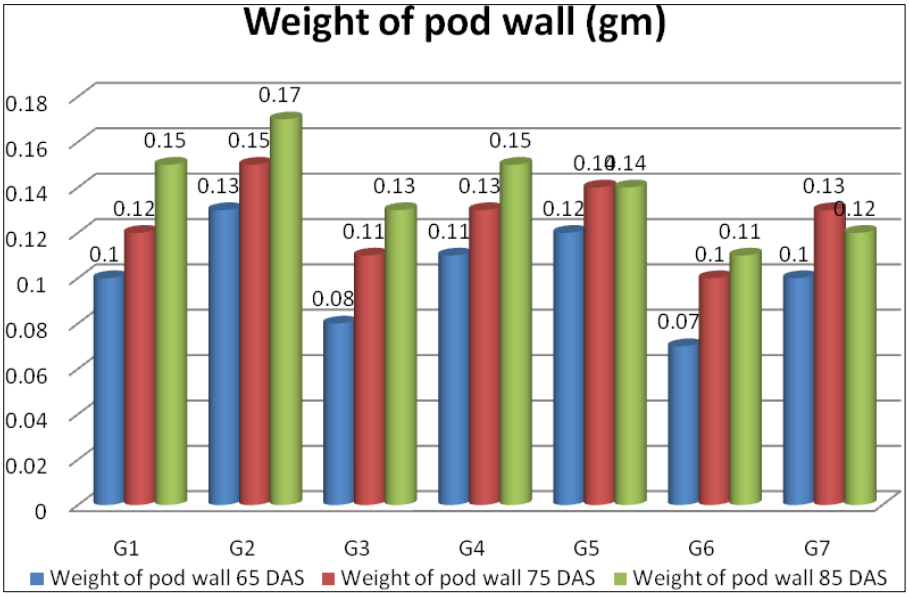
Graph 3: Variation in length of pod in soybean genotypes



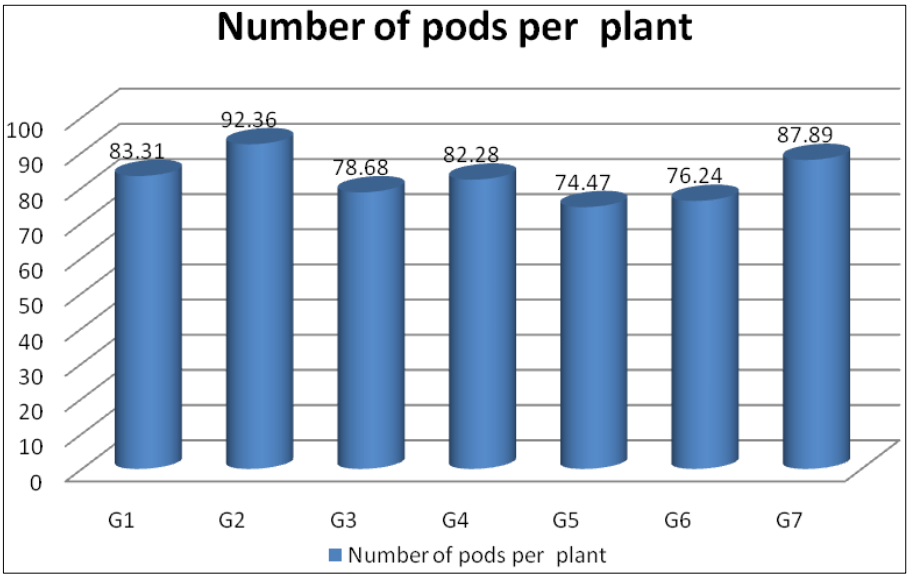
Graph 4: Variation in diameter of pod in soybean genotypes



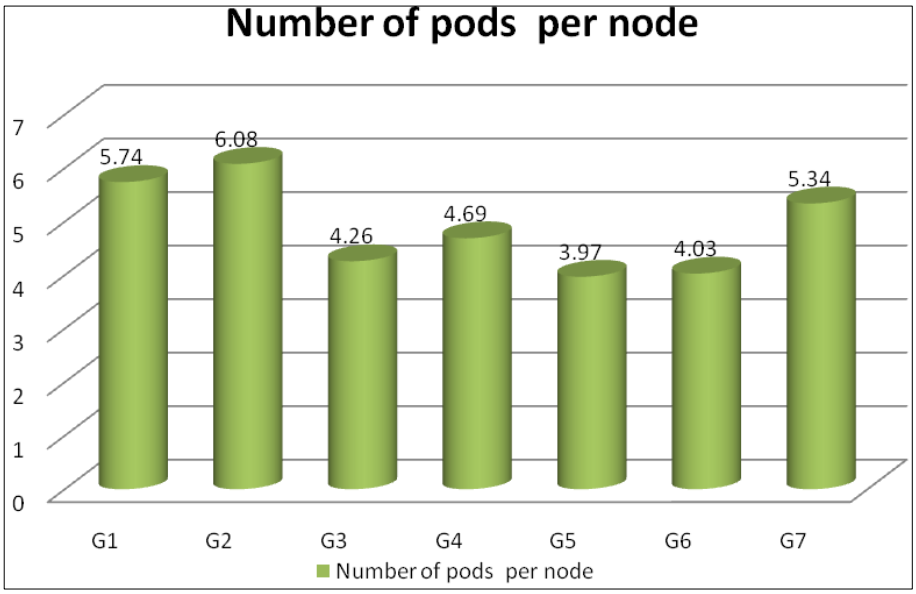
Graph 5: Variation in developing seed weight in soybean genotypes



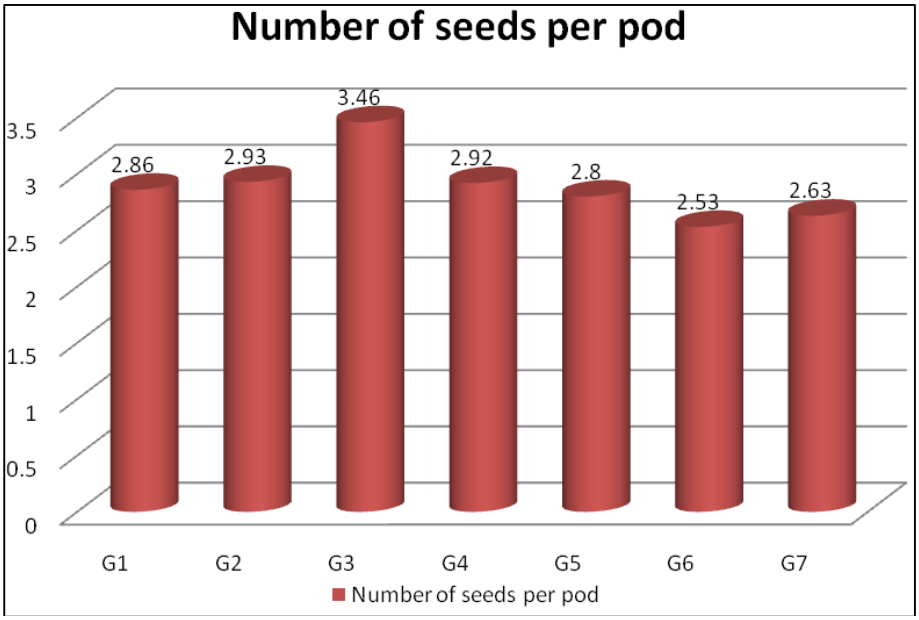
Graph 6: Variation in weight of pod in soybean genotypes



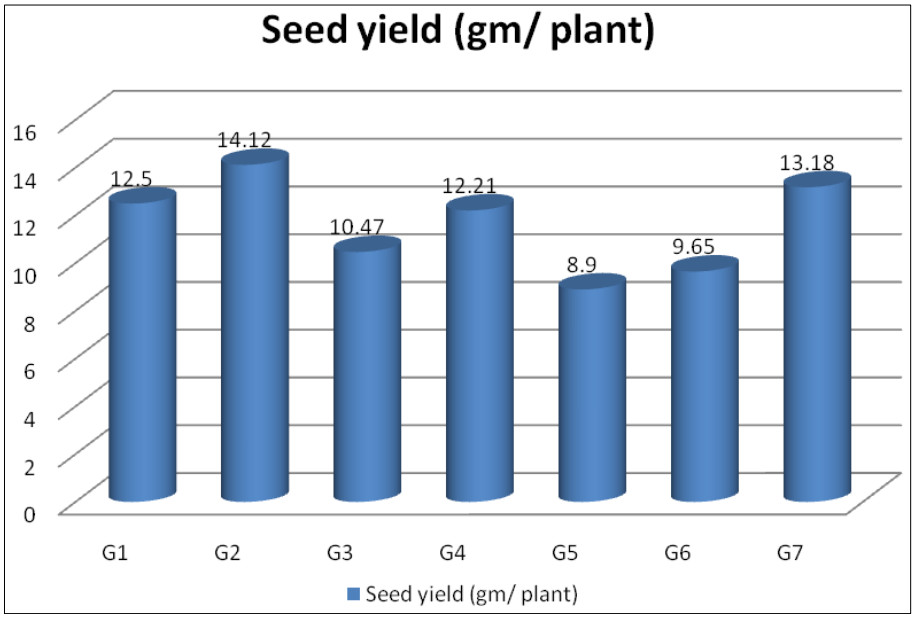
Graph 7: Variation in number of pod per plant in soybean genotypes



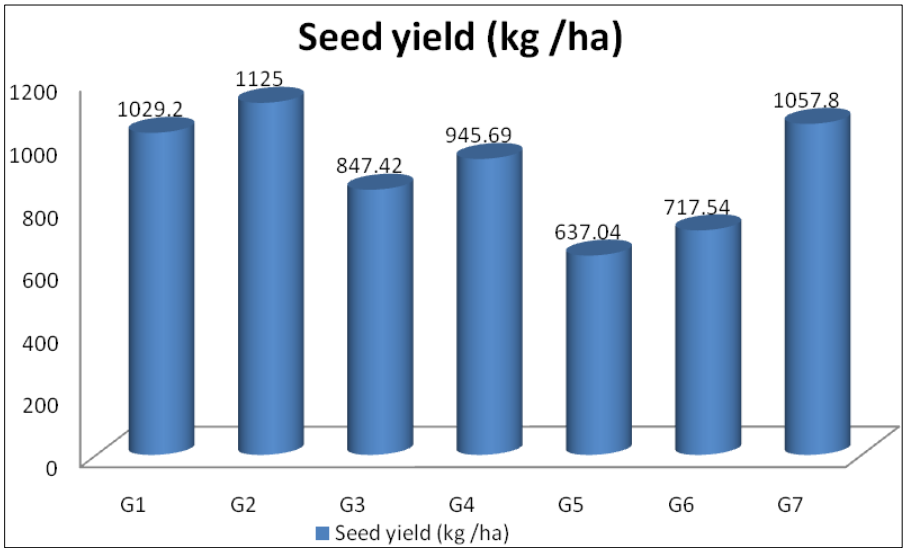
Graph 8: Variation in number of pod per node in soybean genotypes



Graph 9: Variation in number of seeds per pod in soybean genotypes



Graph 10: Variation in seed yield gm per plant in soybean genotypes



Graph 11: Variation in seed yield kg per ha in soybean genotypes

Conclusion

From the result obtained in the present investigation, it is concluded that, for the all studied parameters Viz., pod length, developing seed weight, number of pods per plant, pods per node, weight of pod wall and seed yield, the genotype MAUS-158 performed better than all the other genotypes. During grain filling stage MAUS 158 recorded higher seed weight at all the time intervals of observations, it is the important for the achievement of good seed yield. Hence these parameters can be useful for the further Soybean improvement programme of breeding.

The genotype like JS-335 and MAUS-71 flowered early and it may useful material for development of early maturity varieties of soybean.

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