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GENETIC VARIABILITY STUDIES IN SOYBEAN GENOTYPES UNDER FOOTHILL CONDITIONS OF NAGALAND

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Abstract: *An experiment was laid out in randomized block design with three replications during kharif, 2015 at the experimental farm of School of Agricultural Sciences and Rural Development, Medziphema campus, Nagaland University to evaluate the genetic performance of twelve genotypes under foot hill condition of Nagaland. Studies were done on nine characters viz., days to 50 percent flowering, plant height, number of primary branches, number of secondary branches, number of pods per plant, number of seeds per pod, days to 80 percent maturity, 100 seed weight and seed yield per plant. The analysis of variance showed that the genotypes differ significantly for all the characters except 50% flowering. The highest genotypic coefficient of variation (GCV) as well as the highest phenotypic coefficient of variation (PCV) was observed in number of pods per plant followed by seed yield per plant. The PCV were higher than the GCV for all the characters indicating the effect of environment on their expression. High heritability coupled with high genetic advance as percent of mean were observed for number of pods per plant, seed yield per plant, 100 seed weight, number of secondary branches, number of primary branches and plant height. Thus selection for these traits may be used as selection criteria in breeding programmes.*

Key words: *Soxhean genotypes, genetic variability, Nagaland.*

Introduction:

Soybean (*Glycine max* L. Merill. 2n=40) is known as the *"Golden Bean"* of the twentieth century. It is a species of legume native to eastern Asia. It is classified as an oilseed rather than a pulse due to its high oil content and its more popular use as a source of vegetable oil and industrial applications such as biodiesel. Soybean possesses a very high nutritional value. It contains about 20 per cent oil and 40 per cent high quality protein. In addition, it contains a good amount of minerals, salts and vitamins and its sprouting grains contain a considerable amount of vitamin C. It has a raft of applications including a source of vegetable oil for human food and industrial uses, as a valued protein source in livestock production, for use in preparing a range of human foods such as traditional foods like tofu and soy milk as well as novel uses as a protein isolate and for textured protein. Soybean also has almost endless applications in industrial products such as lubricants, plastics, waxes and a range of intermediate chemicals including fatty acids. A large number of Indian and western dishes such as bread, chapatti, milk, sweets, pastries *etc.*, can be prepared with soybean. Wheat flour fortified with soybean flour makes good quality and more nutritious chapatti. Soybean oil is used for preparing vanaspati ghee and several other industrial products. Soybean is used for making high protein foods for children. It can be used as fodder, forage can be made into hay, silage etc. Soybeans are very rich in nutritive components. The soy protein has a high biological value and contains all the essential amino acids.

The soybean crop is mainly grown in the states of Madhya Pradesh (also known as soybean bowl of India), Maharashtra and Rajasthan. Soybean acreage and production in the country was steadily increasing till late 1990's and lost its momentum in past few years. The area under the crop steadily increased from 22.5 lakh hectares in 1989-90 to 60.02 lakh hectares in 2001-02 but thereafter the area fell sharply in 2002-03 due to poor monsoon conditions.

The production of soybean during kharif 2014 was 60.249 lakh tones in Madhya Pradesh, 30.721 lakh tones in Maharastra and 5.639 lakh tones in Rajasthan (SOPA, 2016).

Although there is no available record as to when soybean was introduced in India, it has been grown in the northern hills and several other scattered pockets in the country for many years. Several ethnic communities of Northeast India have invented the traditional technology of converting protein rich soybeans into flavored fermented food with easy digestibility and bio nutrients. This is exclusively carried out by the ethnic women in Sikkim, Manipur, Meghalaya, Nagaland, Mizoram and Arunachal Pradesh. The farming community of Nagaland and other states of North Eastern region grow Soybean in small areas to meet out their domestic requirements of Soybean and/or its products. There are bright prospects for popularizing this highly remunerative crop in North Eastern parts of India.

Significant variability exists in Soybean. A large number of varieties with varying duration ranging from 75 days to 125 days and grain size of small to bold are being grown by farmers of our country. The seeds of soybean being the richest source of oil fetch higher price in the market because of its high demand for oil extraction. Soybeans make up about 60% of the overall world oilseed production.

The significant amount of variability in morphological features and quantitative traits needs to be further investigated to pave a path to screen suitable genotypes for North Eastern states in general and the state of Nagaland in particular. The present study was conducted *Kharif* 2015 to aassess the magnitude of genetic variability present in plant population.

Materials and Methods:

The present investigation was carried out at the experimental farm of Department of Genetics and Plant breeding, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema during *kharif* 2015.The experiment site was located in the foothill of Nagaland having an elevation of 310 m above mean sea level with a geographical location of $25^0$45'43" N latitudes and 93°53'04" E longitude; respectively.The experiment was carried out following Randomized Block Design in three replications with twelve genotypes.

Seeds of twelve genotypes of soybean were collected from different areas of Manipur, Nagaland and Madhya Pradesh. One commercial variety (JS 335) is used as check variety.

The seeds were treated with Bavistin® @ 3g per kg of seed and sown on 29th July, 2015. Two-three seeds per hole were dibbled at 20 cm x 15 cm inter row and inter plant distance. Hand weeding was done in regular intervals after sowing to avoid growth of unwanted plants. All the recommended agronomic practices were followed for raising a good crop. Observations for various quantitative and qualitative characters have been recorded. The data collected on the fourteen characters were statistically analyzed for various genetic parameters. The analysis of variance was worked out using the mean performance according to Panse and Sukhatme (1957). The phenotypic, genotypic and environmental coefficient of variation was calculated according to Burton and De Vane (1953). The genetic advance possible through selection was computed following Johnson *et al.* (1955).

Results & Discussion:

The results obtained in the present investigation are presented under the following:

Analysis of Variance: The analysis of variance for all the different characters studied is presented in Table 1. The genotypes differ significantly for all the characters except 50% flowering. All the characters were found significant at 1% level of significance except 50% flowering which was not significant.

Mean performance of genotypes in respect of the characters studied: In accordance of the data from Table 2, the following results were obtained.

For the trait plant height the grand mean was found to be 62.44 cm with a range of 44.33-97 cm with. Local collection Ukhrul showed maximum plant height (97cm) and JS 335 showed least plant

height (44.33 cm). The mean performance of days to 50% flowering was 60.72 days and ranged from 55.67-64 days. The various genotypes under study showed significant variations with respect to days to 50% flowering. Local collection Wokha was earliest to flower (55.67days) followed by JS 335 (56 days) while local collection Khonoma was found to be delayed in flowering (64 days) followed by local collection Ukhrul (63.67days). The range of number of primary branches per plant was 2.8-10.4 with a mean of 4.48 primary branches per plant. The genotypes showed significant variation for number of primary branches per plant. Local collection Ukhrul produced maximum number of primary branches (10.4) while JS 335 produced least number of primary branches per plant (2.8).

Average number of secondary branches per plant ranged from 1-3.6 with a mean of 1.8 secondary branches per plant. The genotypes showed significant variation for number of secondary branches per plant. Local collection Khonoma produced maximum number of secondary branches per plant (3.6) while JS 335, MACS-1407 and RVS 2001-04 produced least number of secondary branches per plant(1). Wide variation was observed for number of pods per plant ranging from 13.67-119.47 pods per plant with a general mean of 35.05 pods per plant. The genotypes showed significant variation for number of pods per plant. Local collection Ukhrul produced maximum number of pods per plant (119.47) while JS 93-05 produced least number of pods per plant (13.67). For the trait number of seeds per pod wide variation was observed ranging from 2-2.8 seeds per pod with a general mean of 2.31 seeds per pod. The genotypes showed significant variation for number of seeds per pod. JS 93-05 produced maximum number of seeds per pod (2.8) while RVS 2001-14 and MAUS 612 produced least number of seeds per pod (2).

The range of days to 80% maturity was 74.33-97 with a mean of 90.39. The genotypes showed significant variation for days to 80% maturity. JS 335 was the earliest to mature (74.33 days) followed by JS 93-05 (81.33 days) while MACS-1407 was found to have delayed in maturity (97 days) followed by local collection Khonoma (96.67 days). The 100 seed weight ranged from 4.56-10.63 g with a mean of 8.36 g. JS 335 produced maximum 100 seed weight (10.63 g) followed by local collection Khonoma (10.54 g) while local collection Wokha produced least 100 seed weight (4.56 g) followed by MACS-1407 (6.29 g). Seed yield per plant varied 4.11-21.11 g with a general mean of 7.83 g. The genotypes showed significant variation for seed yield per plant. Local collection Khonoma produced maximum seed yield per plant (21.11 g) followed by local collection JS 335 (12.24 g) while local collection Wokha produced least seed yield per plant (4.25 g), followed by MACS-1407 (4.35 g).

Parameters for variability for yield and yield related traits: The estimates of variability, coefficient of variation, heritability and genetic advance as percent of mean are given in table 4.3. It was estimated that highest genotypic coefficient of variation (GCV) was observed in number of pods per plant (79.55) followed by seed yield per plant (61.52) while lowest was recorded in days to 50% flowering (0.81) followed by days to 80% maturity (7.03) and number of seeds per pod (10.16). The highest phenotypic coefficient of variation (PCV) was found in number of pods per plant (82.39) followed by seed yield per plant (63.47g) while lowest was recorded in days to 50% flowering (7.97) followed by days to 80% maturity (8.37). The broad sense of heritability ranges from 1.04-98.96. The highest was exhibited in 100 seed weight (98.96) followed by number of secondary branches per plant (96.01) while lowest was recorded in days to 50% flowering (1.04) followed by No. of seeds per pod (69.21). The highest genetic advance as percent of mean was recorded in number of pods per plant (158.24) followed by Seed yield per plant (122.86) while lowest was recorded in days to 50% flowering (0.17) followed by days to 80 % maturity (12.16).

The results obtained from the present investigation are interpreted and discussed in the light of available references.

Mean performance of genotypes: The mean performance of the twelve genotypes under study with respect to yield reveals that highest seed yield was produced by local collection Khonoma followed by JS 335, which were also found to have highest seed weight and number of pods per plant. Local collection Khonoma is cultivated in Kohima district of Nagaland and JS 335 is a high yielding commercial variety of soybean. The high seed yield can be attributed to the favourable climatic conditions prevailing in Medziphema during the investigation i.e. 237.54 mm uniformly distributed rainfall and average maximum & minimum temperature of 30.35□ & 22.4□; respectively.

Genetic variability: The analysis of variance revealed significant differences among genotypes for all characters studied except 50% flowering, indicating high degree of variability present in the material. Variability is considered to be insignificant if its coefficient does not exceed 10%, moderate if the coefficient ranges from (10-20%), and significant if the coefficient exceeds 20%. The studies on genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) produced that the PCV were higher than the GCV for all the characters indicating the effect of environment on their expression. Similar results were reported by Karad *et al.* (2005) and Karnwal and Singh (2009). The PCV and GCV were estimated high in comparison to ECV indicating that variability was influenced by the environment. Similar result was reported by Suneeta *et al.* (2010). The highest GCV and PCV were recorded for number of pods per plant and followed by seed yield per plant which indicates the presence of high extent of variability for these characters. The GCV and PCV values were also found high in number of primary branches, number of secondary branches, plant height and 100 seed weight. Similar results have been reported by Gohil *et al.* (2006), Gupta and Punetha (2007), Aditya *et al.* (2001) and Sultana *et al.* (2005)

Heritability and Genetic advance: Efficient selection for any quantitative traits can be derived from the estimates of heritability accompanied by genetic advance (Johnson *et al.* 1955). Therefore, heritability estimates are coupled with genetic advance for effective selection. Heritability is usually considered to be low if it is less than 30%, moderate between (30-60%) and high if it is more than 60% (Johnson *et al.* 1955). The range of genetic advance as percent of mean is classified as low if it is less than 10%, moderate between (10-20%) and high if more than 20% (Johnson *et al.* 1955). High heritability coupled with high genetic advance as percent of mean were observed for number of pods per plant, seed yield per plant, 100 seed weight, number of secondary branches, number of primary branches and plant height. Similar observations were reported by Saharan *et al.* (2006), Yadav (2007), Nag *et al.* (2007), Patil *et al.* (2011), Mahawar *et al.* (2013) and Dubey *et al.* (2015).

From the present investigation it can be concluded that the highest GCV as well as PCV was observed for number of pods per plant followed by seed yield per plant. The PCV were higher than the GCV for all the characters indicating the effect of environment on their expression. The PCV and GCV were estimated high in comparison to ECV indicating that variability was influenced by the environment.

Further, the broad sense of heritability in 100 seed weight and number of secondary branches per were the highest. The highest genetic advance as percent of mean was recorded in number of pods per plant followed by Seed yield per plant. High heritability coupled with high genetic advance as percent of mean were observed for number of pods per plant, seed yield per plant, 100 seed weight, number of secondary branches, number of primary branches and plant height.

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Table 1: Genetic parameters of yield and its related traits in soybean

Characters	Grand mean	Range	Variance			Coefficient of variation			Heritability	Genetic advance as % of mean
			^2g	^2p	^2e	GCV	PCV	ECV	H^2bs	
Plant height(cm)	62.44	44.33-97	204.755	218.51	13.76	22.92	23.67	5.93	93.71	45.7
Days to 50% flowering	60.72	55.67-64	0.245	23.439	23.2	0.81	7.97	7.93	1.04	0.17
No. of primary branches	4.48	2.8-10.4	4.512	5.187	0.68	47.38	50.8	18.32	86.99	91.03
No. of secondary branches	1.8	1-3.6	0.6	0.625	0.03	43.03	43.92	8.78	96.01	86.87
No. of pods per plant	35.05	13.67-119.47	777.62	834.043	56.42	79.55	82.39	21.43	93.24	158.24
No. of seeds per pod	2.31	2-2.8	0.055	0.08	0.03	10.16	12.21	6.78	69.21	17.41
80% maturity	90.39	74.33-97	40.392	57.268	16.88	7.03	8.37	4.54	70.53	12.16
100 seed weight (g)	8.36	4.56-10.63	3.61	3.648	0.04	22.74	22.85	2.33	98.96	46.59
Seed yield per plant (g)	7.83	4.11-21.11	23.215	24.705	1.49	61.52	63.47	15.59	93.97	122.86

Table 2: Mean performances of 12 genotypes of soybean for nine characters

Genotypes	Plant height	Days to 50% flowering	No. of primary branches per plant	No. of secondary branches/ plant	No. of pods per plant	No. of seeds per pod	Days to 80% maturity	100 seed weight	Seed yield/ plant
JS 335	44.33	56	2.8	1	44.3	2.6	74.33	10.63	12.24
JS 98-63	66.33	62.67	4.27	2.4	38.33	2.2	89.67	7.18	8.88
NRC-37	52.67	62	4.6	1.97	35.6	2.2	94	6.82	7.46
JS 93-05	64	60	3.67	1.47	13.67	2.8	81.33	10.26	5.04
NRC-12	70	63	3.67	1.5	28.87	2.2	93.67	8.83	5.96
RVS 2001-14	54.33	62	2.87	1.87	23.87	2	88.33	8.70	6.82
MACS-1407	55.33	59.67	2.93	1	26.73	2.2	97	6.29	4.35
MAUS-612	73	61.67	3.4	2.7	41.93	2	95.67	9.23	9.49
Khonoma	71	64	6.93	3.6	119.47	2.6	96.67	10.54	21.11
RVS 2001-04	46.67	58.33	3.67	1	15.2	2.4	89	7.49	4.43
Ukhrul	97	63.67	10.4	1.5	27.2	2.4	89.67	9.75	12.05
Wokha	54.67	55.67	4.6	1.6	35.47	2.13	95.33	4.56	4.25
Grand Mean	**62.44**	**60.72**	**4.48**	**1.8**	**35.05**	**2.31**	**90.39**	**8.36**	**7.83**
SE	3.03	3.93	0.67	0.13	6.13	0.13	3.35	0.16	1
CD at 5%	6.28	8.155	1.39	0.27	12.72	0.265	6.96	0.33	2.07

Plate 1: Field performance of different genotypes of Soybean

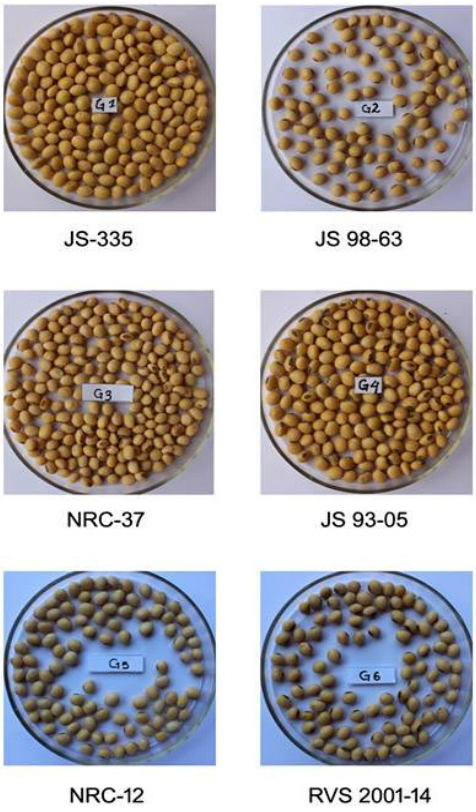

Plate 2: Variability in seeds of different genotypes of Soybean

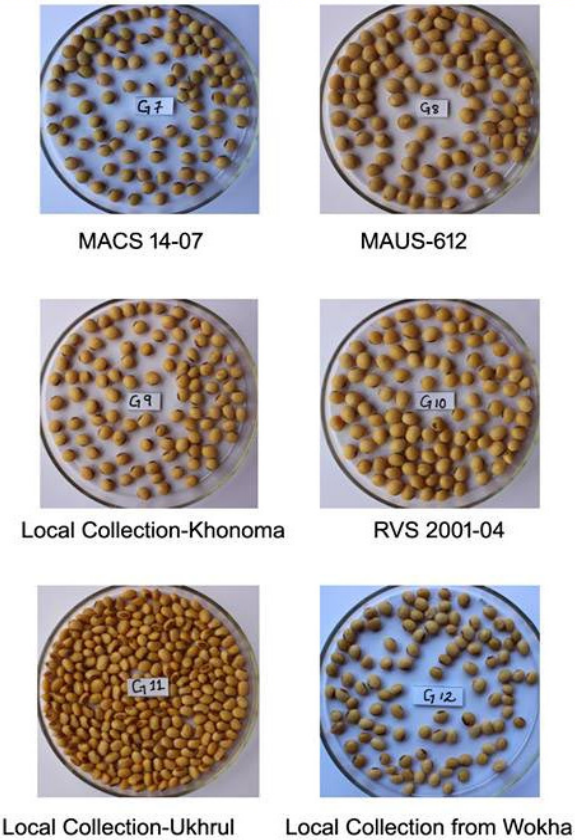

Plate 3: Seed variability in Soybean genotypes