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EVALUATION OF SPANISH BUNCH ADVANCED BREEDING LINES FOR FRESH SEED DORMANCY IN GROUNDNUT (*Arachis hypogaea* L.)

Narendra Kumar[1], B.C. Ajay, M.C. Dagla, A.L. Rathanakumar, Chuni Lal, Radhakrishnan T.M.Y. Samdur, R.K. Mathur, P. Manivel, A.D. Makwana and B.M. Chikani

ICAR-Directorate of Groundnut Research, Ivnagar Road, PB No.5, Junagadh-362 001, Gujarat, India

[1]Corresponding author, E-mail: narendrapb09@gmail.com

ABSTRACT

A study was carried out using 18 Spanish bunch groundnut genotypes to identify fresh seed dormant genotypes. Analysis of variance revealed that significant genotypic differences and genotype × year interaction for germination per cent at different weekly intervals. Two year study results showed that six advanced breeding lines *viz*., PBS 12171, PBS 12187, PBS 12189, PBS 12190, PBS 12191 and PBS 12192 identified for >35days duration of fresh seed dormancy, highest intensity and degree of fresh seed dormancy. Two advanced breeding lines PBS12193 and PBS 12196 identified for 28 days duration of fresh seed dormancy along with highest intensity and degree of fresh seed dormancy. However, an advanced breeding line PBS 12195 identified for 21 days duration of fresh seed dormancy along with average highest intensity and degree of fresh seed dormancy while one genotype ICGV 86031 also had 21 days duration of fresh seed dormancy along with average high intensity (94.4%) and degree of fresh seed dormancy (7.5). One advanced breeding lines PBS 12197 identified for 14 days duration of fresh seed dormancy along with high intensity (97.8%) and degree of fresh seed dormancy (7.5) during 2014 and 2015. Therefore, these genotypes were identified as new sources of fresh seed dormancy with different duration, high intensity and high degree of fresh seed dormancy. These genotypes could be used as donor parent in breeding programmes to develop high yielding Spanish bunch varieties with 2-5 week fresh seed dormancy in groundnut.

Key words : *Fresh seed dormancy, advanced breeding lines, Spanish bunch, genetic variation.*

Groundnut (*Arachis hypogaea* L.) is an important oilseed, food and fodder crop and valued as a rich source of oil (48–50%) and protein (25–28%). Groundnut belonging to Spanish (subsp. *fastigiata* var*. vulgaris*) and Valencia (subsp. *fastigiata* var*. fastigiata*) types have short life cycle and are generally don't have dormancy and Virginia (subsp. *hypogaea* var. *hypogaea*) have longer life cycle with seed dormancy (1). In India, groundnut is cultivated in the rabi-summer period, rainy and post-rainy seasons and prolonged seed dormancy is an undesirable character; however, a short period of 10-15 days fresh seed dormancy is required in the Spanish type of groundnut to prevent in-situ seed germination in the field due to unseasonal rains at the time of crop maturity (2). The Spanish bunch cultivars of ssp. fastigiata are popular in the short growing conditions particularly under rainfed condition because of their early maturity and easy harvesting. But due to lack of seed dormancy in the Spanish bunch varieties have a major problem resulting in 20-50% loss in pod yield due to in-situ germination resulting from unpredictable rainfall at the time crop maturity (3). Persistence of fresh seed dormancy in groundnut also has a significant influence on crop establishment and seed vigour, though it depends on cultural practices followed (4). The genetic variability for seed dormancy in ssp. fastigiata has been well demonstrated by (5, 6). Therefore, objectives of this study was evaluation of Spanish advanced breeding materials is required to study genetic variability for fresh seed dormancy and to identify genotypes with 2-3 week seed dormancy period in ssp. fastigiata background, which can be utilized in breeding programme to develop short duration Spanish groundnut varieties having fresh seed dormancy to avoid yield losses due to in-situ germination in field and to identify genotypes for fresh seed dormancy having high intensity, long duration of dormancy and high degree of fresh seed dormancy.

MATERIALS AND METHODS

Plant material and field experiment : The experimental material consisted of 13 Spanish advanced breeding lines with five high yielding popular Spanish bunch varieties *viz*., TAG 24, TG37A, GPBD 4, ICGV 86031 and Dh 86. These genotypes were harvested at maturity as indicated by blackening of inner parenchyma of the pod (7). To study fresh seed dormancy, a sample of mature pods was randomly collected and shelled immediately after harvesting from each genotype. Enough care was taken to prevent any damage of the seed testa, cotyledons and embryo while removing seeds from pods. Before sowing the seeds were treated with carbendazim (3g kg^{-1} of seed) fungicides to protect from soil-borne diseases. A total 18 genotypes were evaluated during summer 2014 and 2015 (May-June) at Directorate of Groundnut Research, Junagadh, Gujarat (Lat. 21°31' N, Long. 70°36' E) in medium black calcareous soil. The experiment was laid out in randomized complete block design with three replications. Each replication consisted of 20 fresh

Table-1: Analysis of variance for germination percentage at weekly intervals.

Sources of variation	DF	7DAS	10DAS	14DAS	21DAS	28DAS	35 DAS
Year	1	0.06	0.46	0.01	0.04	0.15	0.07
Rep (Year)	4	0.01	0.01	0.01	0.01	0.01	0.01
Genotype	17	0.22**	0.73**	0.99**	0.86**	0.63*	0.57
Genotype× Year	17	0.02**	0.05**	0.01*	0.03**	0.01	0.02
Residual	68	0.01	0.01	0.01	0.01	0.01	0.01
Total	107	0.04	0.13	0.16	0.15	0.11	0.10

*Significance at P< 0.05 level, **Significance at P< 0.01 level.

harvested seeds sown at 2 to 3cm deep for each genotype. The seeds of each genotype were sown at 45 cm spacing between rows and 10 cm between plants. The soil moisture was maintained at field capacity during the growth periodof the test (35 DAS) by irrigation.The observations were recorded on number of seeds germinated at weekly interval until the end of experiment.

Estimated parameters : Fresh seed dormancy is characterized by its duration and intensity.These two parameters were studied in the present investigation for all the genotypes for two seasons. The percentage of germinated seeds for entry at a given date was calculated by the following formula:

Germination (%) = Number of germinated seeds* 100/Total number of sown seeds

Duration of fresh seed dormancy was measured by days taken to attend 50 per cent germination by a genotypeand intensity of fresh seed dormancy was measured as percentage of non-germinated seed at seven days after sowing. These parameters were estimated using the method suggested by (8). Degree of dormancy was classified according to the scale devised by (9).

Statistical analysis : Analysis of variance was performed using the statistical package DSAASTAT (10). The partitioning of means was made with Duncann's multiple range Test at 5% probability level.

RESULTS AND DISCUSSION

Analysis of variance for germination per cent showed that highly significant genotypic differences at all the stages except 28 DAS and non-significant difference at 35 DAS while genotype × year interaction also revealed that highly significant genotype × year interaction differences at all the stages except 14 DAS and non-significant difference at 28 and 35 DAS (Table-1). These results were in agreement with the findings of (5). Presence of interaction effect indicates that germination percent varies from one year to other which could be attributed to environmental conditions. It could be due to environmental conditions like temperature and moisture, others non-genetic factors (11). Germination percentage of genotypes averaged over two seasons is presented in Table-2. At 7th days, an average no germination was observed in the genotypes PBS12189, PBS12190, PBS12192, PBS12193, PBS12195, PBS12196 followed by 2.2 per cent in the genotypes PBS12171, PBS12187 and PBS 12191during both the both the years while highest germination percent was observed in genotypes PBS 12198 (64.4%), followed by TAG 24 (57.8%) and TG37A (44.4%) during 2014-2015. (4) also reported 80% fresh seed germination in TAG 24 cultivar also observed large variation of seed dormancy in Spanish type genotypes. At 14th day germination percentage increased significantly in most of the genotypes and it was highest in PBS 12198 (92.2%) followed by PBS 12194 (78.9%), TAG 24 (75.6%), TG37A (73.3%) and Dh 86 (72.2%) while the genotypes PBS 12192, PBS 12193, PBS 12195 had no increase in germination percent during both the year. These results were in agreement with the findings of (8). At 28th day, all the genotypes hadaverage more than 50% germination during both the year except genotypes PBS12191 (11.1%) followed by genotypes PBS12171 (15.6%), PBS-12190 (20%), PBS 12189 (23.3%) and PBS 12187 (25.6%). (6) also concluded that the groundnut varieties had variation in fresh seed dormancy. It was observed that sufficient genetic variation was showed among all the genotypes studied for germination per cent at different weekly intervals during both the year. Therefore these advanced breeding lines could be used as new sources of fresh seed dormancy for different durations.

Duration of fresh seed dormancy : Genotypes tested showed different durations of dormancy and it was ranged from 7 to >35 days during the year 2014-2015. Results of durations of fresh seed dormancy showed that six advanced breeding lines PBS 12171, PBS 12187, PBS 12189, PBS 12190, PBS 12191 and PBS 12192 had more than 35 days duration of fresh seed dormancy. Two advanced breeding lines PBS 12193 and PBS 12196 had 28 days two genotypes PBS 12195 and ICGV 86031 had 21 days while one advanced breeding lines PBS 12197 had 14 days duration of fresh seed dormancy. It was observed that these genotypes were identified as new sources of fresh seed dormancy which ranged from 2-5 weeks in Spanish bunch groundnut genotypes. In contrast three genotypes *viz*., PBS 12198, TG37A and

Table-2: Germination percentages of genotypes tested at weekly internals in the field after the harvest over two years.

Genotype	2014						2015					
	7 DAS	10 DAS	14 DAS	21 DAS	28 DAS	35 DAS	7 DAS	10 DAS	14 DAS	21 DAS	28 DAS	35 DAS
PBS 12171	0.0^{e}	0.0^{d}	2.2^{e}	4.4^{c}	11.1^{e}	13.3^{c}	2.2^{e}	2.2^{e}	$4.4d^{e}$	15.6^{ef}	20.0^{d}	20.0^{e}
PBS 12187	2.2^{e}	4.4^{d}	8.9^{e}	11.1^{c}	22.2^{e}	24.4^{c}	0.0^{e}	0.0^{e}	$2.2d^{e}$	8.9^{f}	28.9^{d}	28.9^{e}
PBS 12188	22.2^{d}	40.0^{c}	82.2^{ab}	88.9^{a}	88.9^{a}	88.9^{a}	15.6^{de}	80.0^{bc}	84.4^{ab}	97.8^{ab}	97.8^{a}	97.8^{ab}
PBS 12189	0.0^{e}	0.0^{d}	2.2^{e}	9.0^{c}	11.2^{e}	12.2^{c}	0.0^{e}	8.9^{e}	8.9^{de}	28.9^{de}	33.3^{cd}	33.3^{e}
PBS 12190	0.0^{e}	0.0^{d}	2.2^{e}	4.4^{c}	11.1^{e}	11.1^{c}	0.0^{e}	6.7^{e}	6.7^{de}	24.4^{ef}	28.9^{d}	33.3^{e}
PBS 12191	0.0^{e}	0.0^{d}	4.4^{e}	4.4^{c}	8.9^{e}	24.4^{c}	2.2^{e}	2.2^{e}	2.2^{de}	8.9^{f}	13.3^{d}	15.6^{e}
PBS 12192	0.0^{e}	0.0^{d}	0.0^{e}	4.4^{c}	13.3^{e}	24.4^{c}	0.0^{e}	0.0^{e}	2.2^{de}	11.1^{f}	33.3^{cd}	35.6^{e}
PBS 12193	0.0^{e}	0.0^{d}	8.9^{e}	17.8^{c}	42.2^{d}	57.8^{b}	0.0^{e}	0.0^{e}	2.2^{de}	15.6^{ef}	51.1^{bc}	64.4^{cd}
PBS 12194	40.0^{c}	57.8^{b}	93.3^{a}	93.3^{a}	93.3^{a}	93.3^{a}	13.3^{de}	100.0^{a}	100.0^{a}	100.0^{a}	100.0^{a}	100.0^{a}
PBS 12195	0.0^{e}	0.0^{d}	15.6^{e}	48.9^{b}	53.3^{cd}	53.3^{b}	0.0^{e}	0.0^{e}	0.0^{e}	20.0^{ef}	55.6^{b}	60.0^{d}
PBS 12196	0.0^{e}	0.0^{d}	2.2^{e}	13.3^{c}	48.9^{cd}	64.4^{b}	0.0^{e}	4.4^{e}	4.4^{de}	26.7^{ef}	60.0^{b}	60.0^{d}
blPBS 12197	4.4^{e}	15.6^{d}	60.0^{c}	62.2^{b}	66.7^{bc}	66.7^{b}	0.0^{e}	46.7^{d}	51.1^{c}	82.2^{bc}	86.7^{a}	86.7^{ab}
PBS 12198	64.4^{a}	91.1^{a}	95.6^{a}	95.6^{a}	95.6^{a}	95.6^{a}	33.3^{bc}	93.3^{ab}	97.8^{a}	100.0^{a}	100.0^{a}	100.0^{a}
TAG 24	57.8^{ab}	68.9^{b}	88.9^{a}	93.3^{a}	93.3^{a}	93.3^{a}	46.7^{ab}	82.2^{bc}	93.3^{ab}	93.3^{ac}	93.3^{a}	93.3^{ab}
TG 37 A	44.4^{bc}	60.0^{b}	82.2^{ab}	86.7^{a}	88.9^{a}	88.9^{a}	48.9^{a}	86.7^{ac}	88.9^{ab}	88.9^{ac}	88.9^{a}	88.9^{ab}
GPBD 4	11.1^{de}	17.8^{d}	68.9^{bc}	82.2^{a}	82.2^{ab}	84.4^{a}	31.1^{c}	75.6^{c}	80.0^{b}	93.3^{ac}	93.3^{a}	93.3^{ab}
ICGV 86031	11.1^{de}	15.6^{d}	42.2^{d}	55.6^{b}	57.8^{cd}	64.4^{b}	0.0^{e}	15.6^{e}	17.8^{d}	42.2^{d}	55.6^{b}	62.2^{cd}
Dh 86	42.2^{c}	71.1^{b}	95.6^{a}	95.6^{a}	97.8^{a}	97.8^{a}	20.0^{cd}	73.3^{c}	77.8^{b}	80.0^{c}	80.0^{a}	80.0^{bc}

TAG 24 had only = 7 days durations of fresh seed dormancy during both the years (Table-3). These results were in agreement with the findings of (8) also observed that two advanced breeding lines PBS 12115 possessed fresh seed dormancy of 21-28 days, while PBS 12126 possessed fresh seed dormancy of about 14-21 days.

Intensity of fresh seed dormancy : According to (8) intensity of dormancy is defined as the percentage of seeds that not germinated seven days after the harvest. Intensity of dormancy ranged from 35.6% to 100% and 51.1% to 100% during 2014 and 2015 respectively (Table 3). The result showed that six advanced breeding lines *viz*., PBS 12189, PBS 12190, PBS 12192, PBS 12193, PBS 12195, PBS 12196 had 100% intensity of fresh seed dormancy during both the year while the genotype TAG 24 (47.7%), PBS 12195 (51.1%) and TG37A (53.3%) had lowest intensity of dormancy during both the year. This large variation could be due to genetic variation among the genotypes. These findings are in agreement with the results of (8). Also reported large genetic variation in the intensity of dormancy.

Degree of fresh seed dormancy : Degree of fresh seed dormancy of genotypes was done as per the 0 to 8 scales of (12), wherein scale 0 indicates least dormant and scale 8 indicates most dormant genotype. In the present study it was ranged from 3-8 during both the year. Results revealed that six advanced breeding lines PBS 12189, PBS 12190, PBS 12192, PBS 12193, PBS 12195, PBS 12196 had an average score 8 while five genotypes *viz*., PBS 12171, PBS 12187, PBS 12191, PBS 12197 and ICGV 86031 had an average score 7.5 during both the year. Therefore, these genotypes identified as high degree offresh seed dormancy than other genotypes. The present results are in agreement with the observations made by (8).

CONCLUSION

Advanced breeding lines along with high yielding cultivars evaluated for fresh seed dormancy showed significant genetic variation was observed for germination percent at different weekly intervals, duration, intensity and degree of fresh seed dormancy in groundnut. Based on the two year evaluation it was concluded that six advanced breeding lines PBS 12171, PBS 12187, PBS 12189, PBS 12190, PBS 12191 and PBS 12192 had more than 35 days duration of fresh seed dormancy, highest intensity (100%) and degree of fresh seed dormancy (8). Two advanced breeding lines PBS 12193 and PBS 12196 had 28 days duration of fresh seed dormancy along with average highest intensity (100%) and degree of fresh seed dormancy (8).

Table-3: Duration, intensity and scale of dormancy among the genotypes during 2014 to 2015.

Genotype	Duration of dormancy (Days)		Intensity of dormancy (%)		Dormancy scale	
	2014	2015	2014	2015	2014	2015
PBS 12171	>35	>35	100.0	97.8	8	7
PBS 12187	>35	>35	97.8	100.0	7	8
PBS 12188	14.0	10	77.8	84.4	6	7
PBS 12189	>35	>35	100.0	100.0	8	8
PBS 12190	>35	>35	100.0	100.0	8	8
PBS 12191	>35	>35	100.0	97.8	8	7
PBS 12192	>35	>35	100.0	100.0	8	8
PBS 12193	35.0	28	100.0	100.0	8	8
PBS 12194	10	10	60.0	86.7	4	7
PBS 12195	21	28	100.0	100.0	8	8
PBS 12196	28	28	100.0	100.0	8	8
PBS 12197	14	14	95.6	100.0	7	8
PBS 12198	7	10	35.6	66.7	3	5
TAG 24	7	7	42.2	53.3	4	4
TG 37 A	7	7	55.6	51.1	4	4
GPBD 4	14	10	88.9	68.9	7	5
ICGV86031	21	28	88.9	100.0	7	8
Dh 86	10	10	57.8	80.0	4	6

However advanced breeding line PBS 12195 had 21 days duration of fresh seed dormancy along with average highest intensity (100%) and degree of fresh seed dormancy (8) while one genotype ICGV 86031 also had 21 days duration of fresh seed dormancy along with average high intensity (94.4%) and degree of fresh seed dormancy (7.5). One advanced breeding lines PBS 12197 had 14 days duration of fresh seed dormancy along with high intensity (97.8%) and degree of fresh seed dormancy (7.5) during 2014 and 2015.Therefore, these genotypes were identified as new sources of fresh seed dormancy in groundnut for different duration, intensity and degree.

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