INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 14, No. 6, p. 399-406, 2019

RESEARCH PAPER OPEN ACCESS

Morphological characterization of four peanut (*Arachis hypogaea* L.) varieties under Lal-lo, Cagayan condition: Its phenotypic changes to type II climate of the Philippines

Angelina T. Gonzales*, Marissa Isnec

College of Agriculture, Cagayan State University, Lal-lo Campus, Lal-lo, Cagayan, Philippines

Key words: Branching pattern. Constriction, Elliptic, Glabrous, Lanceolate, Pod beak, Pod reticulation, Stem pigmentation

http://dx.doi.org/10.12692/ijb/14.6.399-406 Article published on June 30, 2019

Abstract

The study was conducted to characterize the four peanut varieties during wet season with type II climatic condition in terms of its morphological characteristics. The treatments used were: T1 – Luna Seeded, T2 – BPIPn9, T3 – NSICPn11, T4 – NSICPn17. These were randomly allocated in the different plots following the Randomized Complete Block Design (RCBD). The results of the study are: (1) erect growth habit, stem pigmentation, glabrous type of hairiness, alternate types of branching pattern, opposite leaf arrangement, yellow-orange flower color in all varieties were noticed; (2) leaflet shape: luna Seeded and NSIC11 exhibited elliptic while BPI Pn9 and NSIC17 exhibited lanceolate; (3) leaf color: luna Seeded and NSIC17 exhibited a dark-green while BPI Pn 9 and NSIC 11 exhibited light-green (3) pod Beak.: Luna Seeded and BPI Pn 9 exhibited prominent types, however, NSIC 11 and NSIC 17 has slight type; (3) pod constriction: Luna Seeded, BPI Pn 9 and NSIC 17 exhibited prominent types, while NSIC 11 has a moderate type (4) pod reticulation: Luna Seeded, BPI Pn 9 and NSIC 11 gave prominent types, however, NSIC 17 has a slight type; and (5) primary seed color: pink were predominantly noticed in Luna Seeded, BPI Pn9 and NSIC17, while NSIC11 has a tan seed color. The four peanut varieties are suitable under type II climatic condition. However, it is important that genetic purity and viability of the germplasm is maintained as a separate activity of agricultural R & D agencies.

* **Corresponding Author:** Angelina T. Gonzales ✉ angelinatadurangonzales@yahoo.com

Introduction

Peanut or groundnut is one of the priority products of Ilocos Region and Cagayan Valley. The two regions account for 53% of the national production. Peanut cultivation has become an important livelihood strategy in these two regions especially among smallholders. It is a versatile crop that provides growers with many options to spread risk. With a short growing season, peanut fits well as a cash crop within a diverse range of cropping systems. Peanut production stimulates local food processing industries and adds value to the crop (DA-VCA, 2014).

The average contribution of the Philippines in the peanut production of Asia (66.2% of global production) is relatively low with only 0.07% minimal share, where the crop is grown mostly by smallholder farmers under rainfed conditions with limited inputs. In 2013, although there are productive regions realizing a production ranging from 1.26-2.8 MT/ha, many of the production areas in the Philippines are small and receive low levels of management and farm inputs. Still, the country's production is very small compared to China's yield of about 3.5 MT per hectare, and to United States of about 4.5 MT/hectare. These are because China has a very intensive production method, while high yield in the United States is attributed to the use of high yielding runner varieties, good agronomic practices, and the "mechanization revolution".

In the international trade, the total annual production was estimated at 41,308,175 MT. China is the world's largest producer and in 2013 they accounted for 39% of the world production. Other top peanut producing countries are India (17%), Nigeria (8%), United States (5%), and Myanmar (3%). Peanut production in the United States in 2013 went down by 33% over 2012 performance due to drought. On the other hand, production in India in 2013 increased by 5% over 2012 output. World production grew by an average of 3% per year. For the Philippine peanut industry to become globally competitive, the yield, both in volume and quality must be given attention. Breeding for varietal improvement (for desired peanut characteristics to improve peanut sustainability include early maturity, disease resistance and improved yield is a routinary activity for successful peanut production. These activities are anchored in a very basic agricultural endeavour of identifying suitable variety for a particular area. This this study is bound in the above premise. Thus, this study was conducted to determine the morphological characteristics of peanut which includes: growth habit, stem pigmentation, stem hairiness, branching pattern, leaflet shape, leaf color, leaf arrangement, flower color, pod beak, pod constriction, pod reticulation, and seed color.

Materials and methods

Location of the experimental area

The study was conducted at the experimental area of Cagayan State University at Sta. Maria, Lal-lo, Cagayan. It has a relatively flat topography with clay-loam type of soil having an organic matter content of 3.30%, pH 5.46, phosphorus 3.20 ppm, potassium 180 ppm respectively (Soil Analysis, 2017). The area was cleared from grasses and other foreign materials, plowed and harrowed two times at one (1) week interval to keep the soil loose and fine. After the last harrowing, lay-outing was done according to the design. Furrows at a distance of 50cm were set in every treatment.

Experimental Layout and Design

From the prepared area, 731 square meters was laid out before planting consisting of three (3) equal blocks. Each block has a dimension of 5m x 43m having a one meter alleyway between blocks and one (1) meter between plots. Each block was further subdivided into four (4) plots measuring 5m x 10m. The experimental treatments were randomly allocated in the different plots following the Randomized Complete Block Design (RCBD). The experimental treatments were: T1 – Luna Seeded; T2 – BPI Pn 9; T3 – NSIC Pn 11, and T4 – NSIC Pn 17 (Fig.1)

Application of Seed Inoculant, Planting and Thining

The different peanut varieties were inoculated with rhizobia before planting following the slurry method. Inoculation was done under the shade and the inoculated seeds were planted immediately.

Then, the seeds were planted 50cm between furrows and 25cm between hills in a row. The proper rate of seeding was 2-3 seeds per hill at sowing depth of 5cm. Deeper sowing results in delayed emergence, elongated hypocotyls, and poor nodulation and root and shoot development. The seeds were dropped along the furrows and were covered with fine soil and slightly pressed to have an easy absorption of soil moisture and to ensure a proper contact of seeds with the soil for good germination.

Thinning was done two weeks after planting maintaining two (2) healthy plants per hill to minimize overcrowding and to avoid too much competition of plants for sunlight and food elements from the soil. While for the care and management of the crop, the weeds visible in the area were eliminated by hand weeding as the need arose to protect the plants from the competition of nutrients, solar energy, water and space. Hilling-up was done at 10 days after planting to provide aeration for the plants and to suppress the growth of the weeds. Watering the plant was done as the need arose. Frequent field monitoring was done for possible damage of insect pest and diseases. When plants started to flower, ***t***en representative sample plants were randomly taken at the middle portion of each plot. White-painted bamboo sticks were used to determine the sample plants.

Harvesting and Drying

Maturity was indicated by the normal yellowing of the foliage and shedding of the dry leaves. The presence of reticulation of pods and darkening of the veins of the inner wall of the shell husk was also used as basis. After the four peanut varieties reached its maturity stage at about 90 days to 110 after planting, sample plants were separated according to treatments. Harvested pods were sundried for three days depending on the weather condition.

Data Gathered

Observation on morphological characteristics namely, Growth Habit, Stem Pigmentation, Stem Hairiness, Branching Pattern, Leaflet Shape, Leaf Color, Leaf Arrangement, Flower Color, Pod Beak, Pod Constriction, Pod Reticulation and Primary Seed Color were recorded and described according to 'Groundnut Descriptors' published by International Board for Peanut Genetic Resources (IBPGR), (Rao and Bramel 2000).

Fig. 1. Experimental view of the treatments representing the four peanut varieties: (a)T1- Luna Seeded (b) T2- BPI Pn 9 (c) T3 – NSIC 11 (d) T4 – NSIC 17 under CSU Lal-lo condition during wet season.

Results and discussion

Morphological Characteristics

Growth Habit

Erect (bunch) were noticed in T1 (Luna Seeded), T2 (BPI Pn 9), T3 (NSIC 11) and T4 (NSIC 17). The groundnut plant has a distinct main stem and a variable number of lateral branches. The carriage of laterals determines the growth habit of the plant.

Two distinct forms of growth habit – spreading (runner, trailing, procumbent and prostate) and erect (upright, erect-bunch, and bunch) – have long been recognized and have provided the basis for both agronomic and taxonomic classification.

There has been no agreement on classification on growth habit on groundnut (Rao N.K. and Bramel P.J. 2000).

This is further complicated by the complexity of inheritance of this character. A large number of intermediate forms occur because of cytoplasmic and genetic factors that interact together and also interact with light environments for the expression of growth habit (Zaman MA, *et al.*, 2011).

Recognizing bunch (erect) and runner (trailing) forms as the major forms, it was suggested that the cytoplasmic-genic interactions that determine growth habit act on the biosynthetic pathways, producing phytohormones and their inhibitors.

Table 1. Morphological Characteristics of Four Peanut Varieties evaluated under CSU Lal-locondition during wet season (after the method of H.D. Upadhyaya, R.P.S. Pundir, Sube Singh and C.L.L. Gowda. 2005).

Morphological Characteristics	Peanut Varieties			
	Luna Seeded	BPI Pn 9	NSIC 11	NSIC 17
Growth habit	erect	erect	erect	erect
Stem pigmentation	present	present	present	present
Stem hairiness	glabrous	glabrous	glabrous	glabrous
Branching pattern	alternate	alternate	alternate	alternate
Leaflet shape	elliptic	lanceolate	elliptic	lanceolate
Leaf color	dark-green	light-green	light green	dark-green
Leaf arrangement	opposite	opposite	opposite	opposite
Flower color	yellow-orange	yellow-orange	yellow-orange	yellow-orange
Pod beak	prominent	prominent	prominent	slight
Pod constriction	prominent	prominent	moderate	prominent
Pod reticulation	prominent	prominent	prominent	slight
Seed color	pink	pink	tan	pink

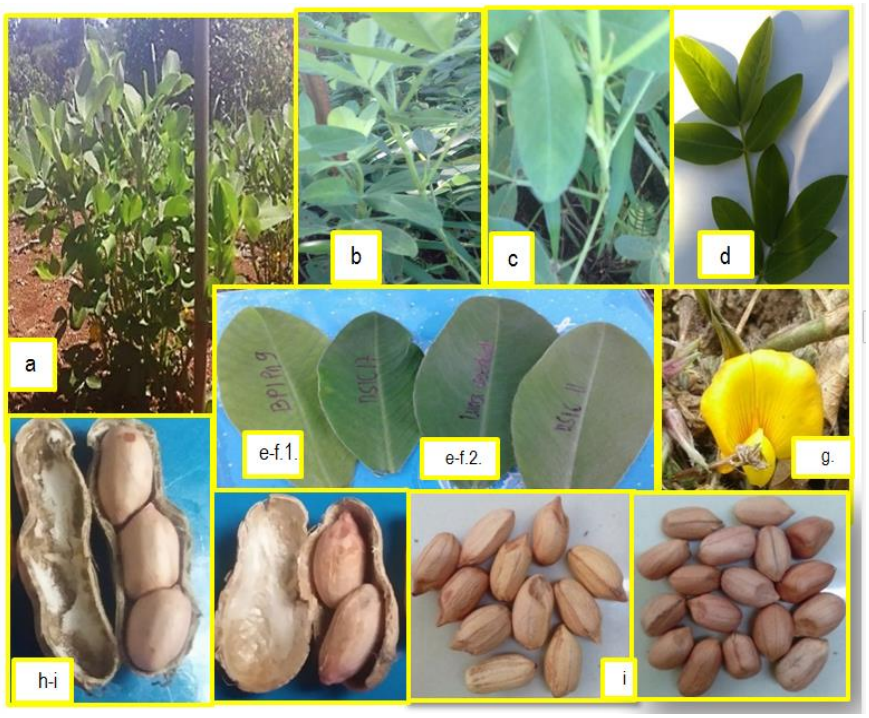

Fig. 1. Typical illustration of different morphological characteristics in peanut: (a) erect growth habit in Luna Seeded; (b) presence of stem pigmentation in BPI Pn 9; (c) glabrous stem hairiness in NSIC 11; (d) opposite leaflets; (e.) leaflet shape (e.l) lanceolate to (e.2.) elliptic; (f) leaf color (f.1.) light green to dark green; (g) yellow orange color of the flower; (h) prominent to moderate pod beak and pod constriction; (i) pink to tan bean color.

The above discussion suggests that growth habit is not a discrete character, and its inheritance is complex. Several loci interacting among themselves and with the cytoplasm may produce various grades. However, for a given homozygous accession, its growth habit can be defined as stable.

In the earlier classifications, the runner and spreading bunch forms were associated with alternate branching (subsp. *hypogaea*) and the erect habit with sequential branching (subsp. *Fastigiata*) (Zeeman, J. *et al*, 2010). Growth needs to be described purely on the basis of observations on plants grown at wide spacing in a given environment. Nevertheless, it must be noted that a vast majority of runner and spreading bunch forms show alternate branching, while the erect forms are generally sequentially branched.

The major collections would include, along with landraces, a number of accessions derived through breeding and also accessions from South America. A certain amount of introgression might have occurred at sub specific level in the center of diversity. In such germplasm the following growth habits could be observed which are based only on the carriage of plant and the position of the primary branches in relation to main stem (IBPGR/ICRISAT, 1981):

Procumbent 1: The main stem is erect and may vary in height. The lateral branches are prostrate.

Procumbent 2: This is similar to procumbent 1, but the main stem has a tendency to bend and continue to trail on the ground. This type is generally encountered in wild *Arachis*.

The common runner (=spreading, trailing, creeping or prostrate) habit group includes the above two forms:

Decumbent 1: The main stem is distinct. The laterals, which normally trail on the ground, tend to become upright at distal nodes.

Decumbent 2: The main stem is distinct. The laterals tend to be almost upright at the median nodes.

Decumbent 3: The main stem becomes indistinct as most of the lateral branches are almost upright and give the plant a bushy appearance.

The spreading bunch (= semi-spreading, bunch runner and runner bunch) group generally includes the above three forms.

Erect: The main stem is indistinguishable from the laterals. The laterals are at an acute angle to the main stem. This form includes the erect bunch of bunch groups in the earlier classification.

Stem Pigmentation

Presence of stem pigmentation were observed in T1 (Luna Seeded), T2 (BPI Pn 9), T3 (NSIC 11) and T4 (NSIC 17). The stem is generally angular, pubescent and solid with a large central pith in the early stages. As the plant grows, stems tend to become hollow and cylindrical and shed most of the hair, especially on lower internodes.

Anthocyanin pigments in the epidermal cells of the stem can give different shades of color. Stem color is determined by the absence or presence pink, dark red, light red, or green (absence of anthocyanin) and numerous shades of purple, pink and red. The color development is influenced significantly by exposure to sunlight and recording typical color is generally difficult. Hence, the stem color could be recorded as present or absent, classifying the cultivars into two broad groups.

Stem Hairiness

Glabrous types were observed in T1 (Luna Seeded), T2 (BPI Pn 9), T3 (NSIC 11) and T4 (NSIC 17). Groundnut has been described as a glabrous to hirsute herb, indicating the extent of variability of this character. A range of two to four grades of hairiness were recognized (Rao N.K. and Bramel P.J. 2000). Because of the difficulty in defining various grades of hairiness, it is pragmatic to recognize only two grades: scarce and abundant. Generally, the upper internodes should be observed because of lower levels the hairs are not persistent. The hairs are arranged in regular rows on the stem. It is possible, by careful observation, to classify the arrangement into the number of rows of hairs. (two, four, six and regular).

Usually the following three types of hairs have been observed on plant parts: (a) long hairs (up to 3 mm), are generally septate and uniseriate and distributed regularly. Occasionally, the cell walls of the top three or four cells disintegrate, giving the appearance of a single long cell.

The outer walls may sometimes be thickened; (b) Short hairs (<1 mm), generally occur densely along with the long hairs, and (c) Glandular hairs (trichomes, spines) are long and bristle-like green. The leaflets are pubescent, as are the stems, mainly on the abaxial surface and on the margins. Generally, midribs are also hairy, often more densely than the leaf surface. As described earlier, all the three hair types – long, short and glandular – can be found on petiole, rachis an leaflet. There is significant variation in hair distribution, shape, size, and number in A. *hypogaea*. In wild species, stem hairiness (type and distribution) has taxonomic significance. Five different grades of hairiness can be distinguished: almost and long. Differences grades have been noticed between young and mature leaves.

Branching Pattern

Alternate types were noticed in T1 (Luna Seeded), T2 (BPI Pn 9), T3 (NSIC 11) and T4 (NSIC 17). The arrangement of reproductive axes on main stem and axes on the primary branches is the basis for classifying the branching pattern. Groundnuts were classified into two botanical groups based on the branching pattern which were named as alternate branching and sequential branching (IBPGR and ICRISAT 1992). Such a system was confirmed and used in classifying A. *hypogaea* along with other correlated characteristics. The cultivars of var. *hypogaea* produce numerous secondary and tertiary branches while subsp. *fastigiata* produces a limited number of secondary and rarely tertiary branches. Describing groundnuts as alternate and sequential forms had been found adequate until recently. The order of occurrence of vegetative and reproductive nodes on the basal primary branch of A. *hypogaea* subsp. *hypogaea* var. *hypogaea* was studied. Wide variation was observed in vegetative and reproductive node numbers and it was suggested that the sequence in runner types could be a result of introgression. Because of the large variation, it was felt that branching pattern might not be dependable attribute to classify groundnuts (IBPGR and ICRISAT 1992) However, more studies of this nature, over different environments, would be required to draw such definitive conclusions on such an important character. It is also essential to note that branching pattern should be observed on the cotyledonary lateral, which may be difficult to identify in well-grown runner types.

Leaflet Shape

T1 (Luna Seeded) and T3 (NSIC 11) exhibited elliptic leaf shape while T2 (BPI Pn 9) and T4 (NSIC 17) exhibited lanceolate leaf shape. Leaves are the main site of photosynthesis in plants. Leaf size and shape have been shown to be related to disease resistance. Peanut leaves have four leaflets per leaf, making them a tetrafoliate. The leaflets are elliptical in shape and have a prominent midvein. The leaflets are borne on a slender, grooved and jointed rachis. Groundnut cultivars differ in leaf characteristics such as leaf color, shape, hairiness and size. Stomata appear on both size of the leaf.

Leaf arrangement

T1 (Luna Seeded), T2 (BPI Pn 9), T3 (NSIC 11) and T4 (NSIC 17) have an opposite leaf arrangement. The leaves are opposite, pinnate with four leaflets (two opposite pairs; no terminal leaflet), each leaflet 1 to 7cm long and 1 to 3cm broad. (Young, 2006).

Leaf color

T1 (Luna Seeded) and T4 (NSIC 17) exhibited a dark-green leaf color while T2 (BPI Pn 9) and T3 (NSIC 11) exhibited light-green leaf color. Peanut possesses light-green to dark-green leaves.

Flower color

Yellow-orange color were observed in T1 (Luna Seeded), T2 (BPI Pn 9), T3 (NSIC 11) and T4 (NSIC 17). The most common color of the standard is orange but other colors such as white, lemon-yellow, yellow, yellow-orange and brick-red (garnet, russet-brown, burnt-orange, amber) also occur. The color of the flower (or to be precise, the standard petal) is distinct and cultivar-dependent. The color of the crescent portion is considered separately. As with any color characteristics, observation is quite subjective and can be difficult. The use of a color chart is recommended. Wings and keel are generally yellow or orange-yellow in color. In some accessions is darker orange or purple blush could be found on wings.

Pod Beak

Prominent types were observed in T1 (Luna Seeded) and T2 (BPI Pn 9) however, T3 (NSIC 11) and T4 (NSIC 17) has a slight type. The tip of the indehiscent fruit may end in an appendages called the beak. The prominence or presence or absence of the beak is dependent on the cultivar and is good diagnostic trait. Five grades can be used to classify groundnut based on this character; absent, slight, moderate, prominent and very prominent. There can be some variation between the pods of the same cultivar and the observation may be somewhat subjective; nevertheless, it is very useful character. The shape of pod beak also varies but is very difficult to define.

Pod Constriction

Prominent types were observed in T1 (Luna Seeded), T2 (BPI Pn 9) and T4 (NSIC 17), however, T3 (NSIC 11) has a moderate type. The constriction of the pod is an important character as it affects the developing seed. Non-constricted pods generally have seeds with flattened ends and are in contact with other seeds in the pod. Such a contact sometimes results in embryo damage (Kudama G, 2013). Seeds from unconstructed pods tend to split during shelling and so cultivars with no constriction are generally undesirable. On the other hand, pods with deep constrictions tend to carry soil on them. They also break during harvesting and shelling, reducing the market value. Most commercial cultivars have some constriction between each seed; a few do not, especially the cultivars belonging to subsp. *Fastigiata*.

Pod reticulation

Prominent types were observed in T1 (Luna Seeded), T2 (BPI Pn 9) and T3 (NSIC 11), however, T4 (NSIC 17) has a slight type.

Primary seed color

Pink colors were predominantly noticed in T1 (Luna Seeded), T2 (BPI Pn 9) and T4 (NSIC 17), however, T3 (NSIC 11) has a tan seed color. Color development in the testa was used as one of the several guides for judging the stage of development of the seeds during the 1947 season and was considered as a possible practical test for estimating maturity. However, color of the testae was found to vary considerably in amount, shade, and distribution so that this characteristic appears to be of minor value as an individual of maturity. Probably the most reliable and simple method of determining maturity includes, a combination texture of the seed, color of the testa, tightness with which the seed is held by the shell, absence of fleshy material and change in color on the inner side of the shell, and gross appearance of the outside of the shell.

Conclusion

Generally, the study aimed to evaluate the performance of the four different varieties under Lal-lo condition during wet season, from August 08, 2017 to December 07, 2017, in terms of its morphological characteristics. Based on the result of the study, the four peanut varieties are suitable under Lal-lo condition. Since all of the peanut varieties evaluated phenotypically expressed their morphological characteristics under the condition and gave optimum yield. It is important that genetic purity and viability of the germplasm are maintained as a separate activity of agricultural R&D agencies in the country.

Recommendations

Based from the results of the study, the following are recommended: (a) the Luna seeded peanut variety is recommended for peanut production and suitable to grow under Lal-lo condition as manifested by its computed pod yield results and (b) further study, along this line during dry season is recommended to obtain more conclusive results. The concern for genetic purity and viability is of paramount importance in genebank operations and appropriate procedures need to be outlined , maintained and recorded properly.

References

Basha SM. 1990. Protein as indicator of peanut seed maturity. Journal of Agricultural and Food Chemistry **38,** 373-376.

FAO. 2002–04. Food and Agriculture Organization of the United Nations. Website www.fao.org

German JB, Dillard CJ. 2004. Saturated Fats: What Dietary Intake? American Journal of Clinical Nutrition, Vol. **80,** No. 3, pp. 550-559.

Hoffmann JR, Falvo MJ. 2004. Protein—Which Is Best?. Journal of Sports Science and Medicine, Vol. **3,** No. 3, 2004, pp. 118-130.

ICRISAT. 1992. Descriptors for groundnut. International Board for Plant Genetic Resources, Rome, Italy; International Crops Research Institute for the Semi- Arid Tropics, Patancheru, India.

Kossmann ZJ, Smith AM. 2010. "Starch: Its Metabolism, Evolution, and Biotechnological Modification in Plants," Annual Review of Plant Biology, Vol. **61,** No.1, pp.209-234.

Kudama G. 2013. Economics of Groundnut Production in East Hararghe Zone of Oromia Regional State, Ethiopia. Science, Technology & Arts Research Journa **l2,** 135-139.

Nigam SN, Giri DY, Reddy AGS. 2004. Groundnut seed production manual. Patancheru 502324, AP, India: International Crops Research Institute for the Semi-Arid Tropics. pp 28.

Rao NK, Bramel PJ. 2000. Manual of genebank operations and procedures. In: ICRISAT, Technical Manual no **6,** pp 190.

Reddy LJ, Nigam SN, Subrahmanyam P, Reddy RGS. 1993. Registration of ICGV- 86590, peanut cultivar. Crop Science **33,** 357-358

Schaafsma G. 2000. The Protein Digestibility-Corrected Amino Acid Score. Journal of Nutrition, Vol. **130,** No. 7. pp. 1865-1867.

Upadhyaya HD, Pundir R, Sube PS, Singh and Gowda, LL. 2005. Procedures and protocols to maintain purity and viability of peanut (groundnut) germplasm. In: Improving yield and economic viability of peanut production in Papua New Guinea and Australia. Proceedings of a workshop held in Lae, Papua New Guinea, October 18-19, 2005.

USDA, 2011. National Nutrient Database for Standard Reference, Release 24.

Zaman MA, Tuhina-Khatun M, Ullah MZ, Moniruzzamn M, Alam KH. 2011. Genetic Variability and Path Analysis of Groundnut (*Arachis hypogaea* L.). The Agriculturists **9,** 29-36.