Comparative Field Performance of Plants Developing from Normal and Abnormal Seedlings of Peanuts[1]

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ABSTRACT

The percentage of abnormal peanut seedlings was determined in 18 field plantings during 1973-74. Characteristics of mature plants that developed from normal and abnormal seedlings were compared. Seedlings that emerged 7-10 days later than the field average were identified as abnormal. Plants that developed from abnormal seedlings produced, on the average, less than one-half of the yield of plants that developed from normal seedlings. Pod yields of the plants that developed from abnormal seedlings varied from zero to normal. SMK percentages were significantly different at six of the 15 locations that were measured.

Approximately 95 percent of the plants that developed from abnormal seedlings had abnormal root systems. The most common abnormalities were twisted hypocotyls and/or missing taproots. Abnormal seedlings commonly result from seeds subjected to mechanical impacts during harvesting and processing.

Additional key words: Arachis hypogaea L., root development, radicle, seed quality, groundnut.

A healthy root system is necessary for the normal development of a plant. The root system provides the absorption and transport tissues for the translocation of nutrients and water to the above ground portions of the plant. Yarbrough (6) characterized the peanut (*Arachis hypogaea* L.) plant as having a deep tap root with four distinct ranks of lateral roots that correspond to the tetrarch vascular structure of the primary root. He reported tap roots of over 30 cm length in 11½ day old plants, with a single root producing 100-116 laterals.

Hall *et. al.* (3) stressed the importance of the tap root in nutrient absorption. They reported that four weeks after planting, 95 percent of the P^{32} absorbed by the peanut plant came from directly under the plant. Even after 11 weeks growth 78 percent of the P^{32} was absorbed within a radius of six inches from the tap root. Three weeks after planting the tap root had grown to a depth of 61 cm.

The development of a normal root system is dependent upon a functional root meristem. The peanut seed has a radicle that protrudes beyond the cotelydons. The radicle is inadequately protected from mechanical impacts during harvesting and processing. The root meristem of a protruding radicle may be injured or even killed in a seed receiving a direct impact on the radicle.

Damaged seeds often produce seedlings in which essential organs are either missing or defective.

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When planted in the field, these seeds either decay or produce seedlings with missing or distorted tap roots.

Teter and Miller (5) experimentally injured peanut seed either by removing about 1 mm of the radicle or by crushing the radicle tip with a force of 1800 grams. Either type of injury accentuated curvature of the hypocotyl, caused retarded foliage growth, resulted in abnormal root development, and reduced field stands.

Andersen (1) classified seedlings in a germination test as either normal or questionable. In greenhouse plantings the average weight of the plants that were produced from normal seedlings was 1.2 times greater than those produced from questionable seedlings. She estimated that less than 40 percent of the plants from questionable seedlings would have survived in the field.

Gelmond (2) reported that plants developed from abnormal seedlings exhibited well developed foliage. However, the pod yield from such pants was negligible.

Current seed processing technology is not adequate to separate injured from uninjured seeds. Therefore, each seed lot contains seed with varying degrees of injury. The objectives of this research were to determine the percentages of abnormal seedlings in field stands and to compare vine weights, pod weights, and sound mature kernel percentages of plants that developed from normal and abnormal seedlings.

Materials and Methods

Seedlings were tagged 3-4 weeks after planting at 18 locations in 1973 and 1974. Abnormal seedlings were visually identified as those that emerged 1-4 days prior to being tagged. For each abnormal seedling tagged, an adjacent (within 50 cm) normal seedling was also tagged for comparison. Other seedlings within 10 cm of each tagged seedling were removed so that each pair of plants could develop in a similar environment.

During the two year period, 380 pairs of plants were tagged and evaluated. The 18 locations represented 18 different seed lots. Thirteen locations were planted with the Florigiant variety, two with NC-5, two with NC-2, and one with NC-17. Plants developed under normal cultural practices and field conditions.

A fork was used to lift each plant at harvest. Plants were hung in the shade to dry. When seed moisture was reduced to approximately 10 percent, the pods were removed by hand. Vines and pods were weighed and root development was evaluated. Pods were shelled by hand and determination of sound mature kernel percentage was made for each plant.

A paired t-test and Student's t-distribution (4) were used to test the null hypothesis that the mean differences between normal and abnormal seedling characteristics were zero.

Results and Discussion

Stand counts were taken at each location to determine the ratio of normal to abnormal seedlings. The field plant populations averaged 14 percent abnormal seedlings. The range for the 18 locations was from 5 to 30 percent abnormal seedlings.

At least 20 normal and 20 abnormal seedlings were removed at the time of tagging from each field for observation of the root system. In most cases, the normal seedlings had a well developed tap root and a dense mass of lateral roots. In most cases, abnormal seedlings had twisted hypocotyls and missing or weak and spindly tap roots. The plants shown in Figure 1 are typical of the seedlings observed. Only 17 abnormal seedlings (out of 380 observed) were found to have plumular or cotyledonary bud abnormalities.

Fig. 1. Examples of seedlings tagged 3-4 weeks after planting. Left to right — Normal seedling, abnormal seedling with weak root development, abnormal with twisted hypocotyl and weak root system, and abnormal with no tap root.

Test plants were observed several times during the growing season. The abnormals flowered two weeks later than the normals. They were more sensitive to drought and exhibited visible wilting before normal plants.

Yield of plants from abnormal seedlings was only 40 percent that of normal plants (Table 1) with two percent of the abnormals being sterile. The mean differences in pod weight were highly significant at each location (.01 level). Varietal differences were not observed. Pod weight for the abnormals ranged from zero to the equivalent production of the normal plants. Observation of the root system indicated, however, that the higher yielding abnormals had normal root systems. Such plants were apparently mis-identified at tagging. The delayed emergence of such plants could have been due to dormancy or some factor other than critical impact damage to the radicle.

The mean differences in vine weight were all highly significant. Gelmond (2) reported well developed foliage in many plants that grew from abnormal seedlings. She did not, however, actually weigh the foliage. Visually, many of the abnormals had normal foliage growth. Foliage weight, however, was much less for the abnormals than the normals. Foliage growth was probably retarded because the abnormal root systems were incapable of transporting sufficient nutrients and water for normal growth.

The roots were classified as normal, no tap root, and/or twisted hypocotyl. Five percent of the plants from normal seedlings had twisted hypo-

Table 1. Mean performance by locations of peanut plants developed from normal and abnormal seedlings.

Location	No. pairs of plants	Mean pod weight in grams[1]		Mean vine weight in grams[1]		Mean percentage sound mature kernels[2]	
		Seedling type		Seedling type		Seedling type	
		Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
1	32	101	41	157	62	69.5	66.2
2	24	151	46	178	69	71.9	69.5
3	22	120	53	158	76	71.0	67.8
4	21	102	37	131	53	71.0	62.4
5	21	98	30	114	53	66.7	55.8
6	23	90	44	97	40	74.3	63.8
7	27	76	33	-	-	69.4	68.9
8	17	98	25	84	30	74.0	71.0
9	20	39	15	-	-	73.0	71.8
10	22	170	69	-	-	-	-
11	21	121	41	-	-	-	-
12	21	121	40	-	-	-	-
13	24	59	22	120	52	65.3	63.6
14	21	83	20	112	32	71.3	66.6
15	24	70	24	105	50	68.9	66.8
16	24	60	30	91	39	75.4	72.4
17	20	92	33	79	49	74.2	65.5
18	20	83	34	162	72	69.9	65.0

[1]Each difference significant at the .01% level of significance.

[2]Difference at locations 4, 5, 6, 14, 17 and 18 significant at .05% level of significance. Other differences non-significant.

cotyls and two percent had missing taproots. Ninety-four percent of the plants that developed from abnormal seedlings had abnormal root systems. Sixty-two percent of such plants had twisted hypocotyls and 41 percent had no tap roots. Plants with no tap roots usually developed adventitious roots at the base of the hypocotyl.

Initially, it was assumed that the differences between normal and abnormal plants would relate to degree of maturity, i.e., abnormal plants would have the same yield potential as normal plants if permitted to remain in the field for an equivalent foliage growth period. In only six of 15 locations were there significant mean differences in sound mature kernel percentages, thus indicating normal pod development on the abnormal plants. A reduced pod set on the abnormal plants was related to the reduction in yield.

The morphological features of peanut seed make them susceptible to damage during harvesting and processing. A seed lot with a high potential for development of abnormal seedlings may produce acceptable stands, but yield poorly. Dollar losses could far exceed the cost of planting superior seed. Seedling evaluation methods must be refined to identify more accurantely those seed lots that are prone to develop a high percentage of abnormal seedlings under field conditions.

In field plantings, normal plants compensate in yield for adjacent abnormal plants. Data are not available that permit estimation of the percent yield compensation by normal plants. It is suspected that any yield reduction associated with abnormal plants is related inversely to plant population.

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