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Original Article

Seed Scarification and Day Length Effect on the Germination and Vegetative Growth of Soybeans (*Glycine max*)

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Abstract

Studies were carried out to determine the scarification and day length effects on the germination and early growth of soybean (*Glycine max*). Soil was collected from the biological garden of Yobe State University Damaturu. The soybean seed sample consists of two different treatments including scarified and unscarified seeds with two different levels of day length. A soybean of the tested varieties was sown in a polythene pot with a depth of half an inch. About two seeds mixed with a star dress were sown in each polythene bag. The data collected were analyzed using Genstat software 16 editions versus. Results of the experiments carried out indicate that, the seeds of soybeans have a highest rate of germination percentage when subjected to scarification treatment. From the obtained results, it can be concluded that, there is no effect of scarification on the germination of soybeans but there was significance in the effect of scarification on the vegetative growth in which the plants that were exposed to 12 hours day and 12 hours night grew faster than those exposed to 24 hours. It is therefore believed that the method of preventing dormancy can be used on soybeans in order to improve the growth and subsequent yield of the soybean crop.

Keywords: - *Scarified, un-scarified, Day length, Germination Percentage, Dormancy, Growth*

Introduction

Soybean (*Glycine max L*.) is a leguminous crop that grows well in temperate, tropical and subtropical climates. The crop belongs to the family Leguminosae, in the sub-family Papilionoideae. Soybean is often considered a:" magic bean" by many people due to its economic and dietary uses for the socio-economic life of the populace. Soybean is an important source of high-quality and inexpensive protein (Guo *et al.*, 2021; Adedayo and Babalola 2023). Soybean production is encountering major global challenges due to the increase in its demand as a result of rising population growth and changes associated with climate and other mitigating factors which tend to lower the production of such crops (Chaudhry and Sidhu, 2022; Sambiele 2021).

Soybean has numerous health benefits for humans and livestock, as well as for different commercial and industrial activities. Soybeans are usually classified as oil seeds because they contain large amounts of all the essential minerals, amino acids, and vitamins for a proper human diet. The crop provides an important source of dietary nutrition with average contents of 30% carbohydrate, 40% protein and 20% oil respectively (Zhao *et al.*, 2021).

The soybean is a sensitive day-length crop (Ort *et al.*, 2022; Yurkov et al 2023). Day length is a phenomenal factor that affects the vegetative growth of plants before the flowering process finally sets

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in. In an ideal situation the plants grow to a size of about 2-3 feet before they start flowering. Bigger plants tend to have a large number of seeds; therefore, seed bearing capacity per plant is closely related to the day length requirements of the crop species in relation to the planting season of the crop (Caliskan *et al.*, 2007; Allagulova *et al.*, 2023). Some evidence reveals that melanonin tends to decrease the melanoaldehyde composition of oxygen, water and electrolytes leakages in the seedlings while under stress (Wei *et al.*, 2022; Manafi *et al.*, 2022), therefore environmental stress can slow down the rate of occurrence of these mechanisms by positively regulating homeostasis and reducing stresses caused secondarily brought about by salinity, drought , heat and cold (Cao *et al.*, 2022 ; Imran *et al.*, 2021; Khan *et al.,* 2023) , similarly the addition of melatonin to other physiological attributes of seeds depends on the nature of the abiotic stress involved (Raza *et al.*, 2022 ; Mushtaq *et al.*, 2022 ; Kopecka *et al* 2023).

Soybean (*Glycine max*) is the cheapest of all legumes and with more protein content (Adebayo *et al.*, 2023), the crop is cultivated in Nigeria and many other countries. The use of this product is usually being hampered because its production has been limited to the northern region and most people from the southern parts of Nigeria are not familiar with the crop or its importance. Soybeans crops contain large contents of 40% protein in contrast to 25% protein in cow peas; similarly, the amino acid profile of Soybean is highly related to that of animal products (Adebayo *et al.*, 2023),

The increasing demand for soybean crops has been driven by large, medium, and small-scale processing factories in Nigeria. Soybean is usually processed into different kinds of products in Nigeria and beyond; the most common products include things like edible vegetable oil and soybean meal.

Flowering pathways

Transitional flower is an ecological character in response to various indigenous and environmental cues, such as photoperiod, light quality, ambient temperature, vernalisation, as well as biotic and abiotic factors (Desai et al, 2021). Long day flowering plants are a model for understanding genetic networks by forwarding and reversing genetic approaches (Srikanth *et al.*, 2011; Zeng *et al.*, 2022). Six major genetic routes that usually control flowering include photoperiod, vernalisation, autonomous gibberellins (GA), ambient temperature and the age pathway (Awan *et al.*, 2023). This pathway controls a short from vegetative development by regulating floral meristem identity genes in the short apical meristem (SAM), which result in flower organ development (Wang *et al.* 2021).

Environmental signal of floral initiation

In the last century, many hypotheses were developed to explain how photoperiods such as theories involved in ideas that plants require internal oscillations to synchronize endogenous rhythm with exogenous signals (Baurle *et al.*, 2006). Plants perceive light in the leaves, but not in the shoot apical meristem (Zeevaart, 2006).

Not only day lengths but also the quality and quantity of light play a vital role in flower initiations (Zhong et al, 2021). Plants are usually susceptible to a shift in incoming light rays and colors. Temperature is also another known external factor that controls plant mechanisms for identifying and controlling different life processes, like flowering. Over time, individual observation in the differences between winter and spring annual was a result of an obligate vernalization requirement in winter annuals (Zhong et al, 2021).

Materials And Methods

Experimental Site.

The study was conducted at the biological science garden, Yobe State University Damaturu

The samples consist of two different seed treatments which are the scarified and un-scarified seeds with two different levels of day length (12 hours a day and 12 hours a night), and the control treatment which has a complete 24 hours of light exposure.

Soil Sample Collection.

Soil samples were collected between 0-15cm and 15-30 cm deep from the biological garden of Yobe State University. The soil samples collected were air dried and mixed with cow dung in a 3:1 ratio and filled into the polythene pot.

The dark room was created using a wooden mat and large black leather where the treatment is planted. The treatment was opened to sunlight and covered continuously after 12 hours (from 6 a.m. to 6 p.m.) every day, while the control treatment was exposed to 24 hours of light.

Sowing of seed

Soybeans of the tested cultivars were then sown into polythene bag with a planting depth of about half inch and watered daily.

Data Collection.

Records of the following parameters were obtained for further analysis.

1. Germination percentage
2. Plant height in (cm)
3. Number of leaves
4. Fresh weight
5. Dry weight

Data Analysis

Data obtained were subjected to analysis of variance (ANOVA) test and means were separated using LSD at 5% probability level.

Results

Soil Analysis

Table 1: Physicochemical Properties of the Soil sample

pH	6.2 Slightly acidic
Calcium (Ca)	3.25
Sodium (Na)	0.134
Phasporus (P)	0.18ppm
Potassium (K)	0.07
Magnesium (Mg)	1.6
Nitrogen (N)	2.35ppm
Porosity	7.5%
Soil type	Sandy Loam

Table 2: Scarification and Day Length effect on germination of Soybeans

Treatment	Number of Germination	Percentage (%) of Germination
SE24	15	83.3%
SE12	18	100%
NSE24	13	72.2%
NSE12	17	94.4%

ANOVA

Source of Variation.	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups.	10288.95	1	10288.95	131.2541	2.65E-05	5.987378
Within Groups.	470.3375	6	78.38958			
Total	10759.29	7				

Source: Field research (Biological Garden Yobe state University Damaturu.)

From the above table 2, it was revealed that the germination percentage rate was not significant since the P-value (2.65E-05) > 0.05. The scarified exposed to 12 hours (SE12) has the highest percentage of germination followed by the non-scarified exposed 12 hours (NSE12), scarified exposed to 24

hours (SE24) and non-scarified exposed to 24 hours (NSE24) respectively. The germination percentage has significant difference with p-value 2.65E-05.

KEY: NSE24 (scarified exposed to 24hours), NSE12 (scarified exposed to 12hours), NSE24 (non-scarified exposed to 24 hours) and NSE12 (non-scarified exposed to 12 hours).

The Effect of Scarification and Day Length on Plant Height (cm) of soybeans

The effect of Scarification and Day Length on plant height (cm) of Soybeans (*Glycine max L*) is presented in Table 3 below.

Table 3: Scarification and Day Length effect on Plant Height (cm) of soybeans

Treatment	Weeks after planting				
	1	2	3	4	5
SE24	13.8	18.6	20.5	28.3	29.3
SE12	22.2	29.7	30.3	36.3	43.0
NSE24	10.7	19.0	23.3	25.3	28.5
NSE12	19.8	26.7	30.2	36.3	46.7

ANOVA

Source of Variation.	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups.	956.727	4	239.1818	5.859282	0.004799	3.055568
Within Groups.	612.315	15	40.821			
Total	1569.042	19				

Source: Field research (Biological Garden Yobe state university Damaturu, Yobe state)

From the above table, it shows that the plant height was statistically significant since the p-value (0.004) <0.05. Therefore, the plant height has significant difference between SE24, SE12, NSE24 and NSE12 treatments.

Scarification and Day Length effect on Leaves number of Soybeans

Scarification and Day length effect on leaves number of Soybeans (*Glycine max L.)* was presented in table 4 below.

Table 4: Scarification and Day Length effect on Leaves number of Soybeans

Treatment	Weeks after planting				
	1	2	3	4	5
SE24	2.6	8.0	11.0	15.3	20.0
SE12	4.6	9.3	14.6	19.0	20.6
NSE24	3.0	8.0	12.6	15.6	17.0
NSE12	4.3	9.6	14.0	18.0	20.6

ANOVA

Source of Variation.	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups.	651.923	4	162.9808	77.70238	7.67E-10	3.055568
Within Groups.	31.4625	15	2.0975			
Total	683.3855	19				

Source: Field research (Biological Garden Yobe state university Damaturu Yobe state.)

From the above table, study reveals that the leaves number were not significantly different since the p-value (7.67E-10) > 0.05. Therefore, the number of leaves has no significant difference between SE24, SE12, NSE24 and NSE12 treatments.

Scarification and Day Length effect on Fresh Weight (g) of Soybeans

The effect of Scarification and Day Length on fresh weight (g) of Soybeans (*Glycine max L.)* is presented in Table 5 below.

Table 5: Scarification and Day Length effect on Fresh Weight (g) of Soybeans

Treatment	Weeks after planting				
	1	2	3	4	5
SE24	1.1	2.1	2.7	3.3	7.4
SE12	1.0	2.2	4.7	6.1	8.5
NSE24	1.2	1.7	3.0	3.5	5.7
NSE12	1.2	2.4	3.5	4.7	7.3

ANOVA

Source of Variation.	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups.	88.603	4	22.15075	28.63704	7.25E-07	3.055568
Within Groups.	11.6025	15	0.7735			
Total.	100.2055	19				

Source: Field research (Biological Garden Yobe state university Damaturu).

From the above table, it shows that the fresh weight were not statistically significant since the p-value (7.25E-07)>0.05. Therefore, the fresh weight has no significant difference between SE24, SE12, NSE24 and NSE12 treatments.

Scarification and Day Length effect on Dry Weight (g) of Soybeans

Scarification and Day Length effect on dry weight of Soybeans (*Glycine max L.)* is presented in Table below

Table 6: Effect of Scarification and Day Length on Dry Weight (g) of Soybeans

Treatment	Weeks after planting				
	1	2	3	4	5
SE24	0.13	0.51	0.71	0.80	1.01
SE12	0.40	1.27	2.86	3.35	3.73
NSE24	0.16	0.36	0.64	0.99	1.07
NSE12	0.13	0.40	0.79	0.99	1.27

ANOVA

Source of Variation.	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups.	6.59542	4	1.648855	1.788854	0.183609	3.055568
Within Groups.	13.82608	15	0.921738			
Total	20.4215	19				

Source: Field research (Biological Garden Yobe state university Damaturu).

From the above table, it shows that the dry weight was not statistically significant since the p-value (0.183) > 0.05. Therefore, the dry weight has no significant difference between SE24, SE12, NSE24 and NSE12 treatments.

Discussion

In From the results obtained from the study conducted, findings from the experiments reveal that soybean seeds have a high germination rate when they are exposed to the scarification of seeds. Results show that, the highest rate of germination came from seeds that were exposed to scarification treatment for 12 hours (SE12) day length treatment which has high significance differences between treatments.

Research findings in this present study, with regards to the effect of scarification and day length on the analysis of variance plant height reveal that, there are significant differences between the plant heights because the P-value (0.005) is less than the 0.05 level of significance. Similarly, the analysis of leaf number, fresh and dry weight analysis of variance has no significant differences since the p-value (7.67E-10, 7.25E-07 and 0.184) are greater than the 0.05 level of significance.

The results obtained from this study are also in agreement with Bellaloui *et al.,* (2015) who reported that soybean seed does not have any effect on scarification but does have a high significant effect on its vegetative growth. Differences between growing seasons for the soybean crops were significant for the plant height, whereas those leaf numbers, fresh weight and dry weight are not significant since the p-value is greater than the significant value.

Conclusion

It can be concluded that there is not any effect of scarification on the germination of soybeans, but there was a significant effect of scarification on the vegetative growth, in which the plants that were exposed to 12 hours of day and 12 hours of night grew faster than those exposed to 24 hours.

Soybean vegetative growth is affected by some external environmental factors, like temperature and photoperiodic activities. Late crop planting and non-favorable environmental conditions can have a negative effect on the growth, development, and yield of the soybean crop. Alterations in photoperiod, temperature, and rainfall, coupled with a delayed planting date, will affect the vegetative growth of the soybean crop.

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Conflict of Interest:

The authors declare no conflict of interest.

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