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Effects of Seed Sizes and Varieties on Growth, Yield and Oil and Protein Contents of Groundnut (*Arachis hypogaea* L.)

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Abstract

Two experiments were conducted at upland farm of Yezin Agricultural University in Nay Pyi Taw, Myanmar during rainy season 2010 and winter season 2010–2011. The field experiments were laid out in a split-plot design with three replications. The main plot factor was the four groundnut varieties, which were Sinpadaethar 7, Sinpadaethar 8, Sinpadaethar 9, and Magway 15. The sub plot factor was the three seed sizes, which were graded as small, medium, and large with the use of different sizes of sieves. The effects of groundnut varieties on the yield and other related characters were found to be obvious and significant. The higher pod yield, number of pods per plant, shelling percentage, harvest index, and oil content were observed to be highest in Sinpadaethar 7, and this variety should be recommended to be applied for effective production in terms of pod yield in rainy and winter seasons. The highest protein content was observed in Sinpadaethar 9 and Magway 15 in rainy and winter season, respectively. The effects of size of planting seeds on plant characters were not as obvious as that of variety. The plants from large seeds indicated faster growth rate, especially in the initial growth stage as expressed in higher mean values of plant height, total dry matter, crop growth rate and harvest index in both season. At later growth stages, no significant differences were observed for the above parameters. Oil and protein contents were slightly affected by seed size. Yield components, harvest index and shelling percentage were not affected by seed size. The interaction between varieties and seed sizes was not found in all observations. Therefore, choice of seed size or variety can be done independently for groundnut production. Based on the findings of this study on the effect of seed size on yield, it can be recommended that the smaller seeds can be used as the seed stock for groundnut growers whereas medium and large seeds were used for their income.

Keywords: Groundnut, Myanmar, Seed sizes, Varieties, Yield components

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Introduction

Groundnut is the second most important oilseed crops in Myanmar. More than 70% of total groundnut production is being utilized for edible oil, 20% for seed purpose and limited quantity of groundnut kernel is used for direct consumption as confectionery. The quality seed always plays an important role to the groundnut grower. Good seed is essential for establishing the designed plant population, good development and yield. Seed size is one of the components of seed quality in further crop development. Generally, groundnut growers want to use large and medium seed sizes of groundnut for seed stock because they usually consider that they might achieve the high income and fulfillment of self-sufficiency of oil from those seed sizes. The effect of seed size on crop performance has been observed to differ in crops. The aim of the present study was to compare how seed sizes affect on growth, yield and oil and protein contents of groundnut varieties.

Material and Methods

The experiments were conducted at upland farm of Yezin Agricultural University in Nay Pyi Taw, Myanmar during rainy and winter season 2010–2011. The field experiments were laid out in a split-plot design with three replications. The four groundnut varieties, Sinpadaethar 7 (90-95 days), Sinpadaethar 8 (100-105 days), Sinpadaethar 9 (100-105 days), Magway 15 (110-115 days), were the main-plot factor and the three seed sizes, large (> 8 mm diameter), medium (7 to 8 mm diameter), small (< 7 mm diameter), were the sub-plot factor. Groundnut was sown in an individual plot size of 3 m × 3 m with a spacing of 30 cm × 15 cm.

Results and Discussion

Crop Growth Rate (CGR)

Rainy Season

Crop growth rate as influenced by treatments at different growth periods are presented in Table 1.1. At the final stage of measurement, varietal differences in the rate of growth were significant. Sinpadaethar 8 showed the fastest growth rate (8.01), but it was not significantly different from Magway 15 (7.18) and the slowest growth rate (3.93) was found in Sinpadaethar 7, which was not significantly different from that of Sinpadaethar 9 (6.07). Crop growth rate measured at all intervals were not affected by different seed sizes. Martinson (2009) stated that seed size differences did not affect on crop growth rate and reported that CGR increased rapidly especially after fertilizer application.

Winter Season

Crop growth rate as influenced by treatments at different growth periods are presented in Table 1.2. Between 14-28 DAE, varietal differences in crop growth rate were significant. The CGR of Sinpadaethar 9 (1.07) was significantly higher than that of Sinpadaethar 7 (0.67). At other periods, varietal differences were not observed significantly. The CGR as affected by seed size differences was significant at 14-28 DAE, 28-42 DAE and 42-56 DAE. At these periods, the minimum CGR values (0.62, 1.14 and 0.34) were observed from small seed size and the maximum CGR values (1.21, 1.53 and 1.55) were resulted from large seed size. There were no significant differences among seed sizes at other periods. Martison (2009) reported that larger seeds have larger cotyledons and could capture more light and leads to faster growth and elongation at early growth stages. Groundnut crop is highly susceptible to weed infestation because of its slow growth in the initial stages up to 40 days (Jat et al. 2011). Therefore, weed management is needed at early growth stages, especially for small seed size.

Yield and Yield Components

Rainy Season

The significant difference in pod yield was observed among the tested groundnut varieties (Table 2.1). The highest pod yield (2735.00 kg ha^{-1}) was found in Sinpadaethar 7 and the lowest pod yield (2007.11 kg ha^{-1}) was resulted from Sinpadaethar 9. There was no significant difference in pod yield among the different seed sizes. This finding was confirmed by the work done by Martinson (2009) who reported that the final yield is independent of different seed sizes. This could be assumed that if the same amounts of resources are given, each seed size has the capacity to convert energy and photosynthates into reproductive parts.

Winter Season

Yield and yield components as affected by treatments are presented in Table 2.2. The maximum pod yield (2065.42 kg ha^{-1}) was resulted from Sinpadaethar 7 variety which was not significantly different from other varieties. Difference in tested varieties and seed sizes did not significantly

affect on yield and yield components. The main factor which directly contributed to yield was dependent upon plant species and plant varieties. Small seeded genotypes are probably physiologically most efficient, especially at warmer sites and higher latitudes (White and Gonzalez 1990). Duangpatra (2003) stated that the large and medium seed sizes are used for peanut product and utilization. The small seeds are used for planting. Peanut pod and seed yields obtained from planting small sizes peanut were not significantly different from those obtained from large sized seeds from the same lot. Pod yield of rainy season was higher than that of winter season experiment. Prasad et al. (2000) reported 50 % reduction in pod yield at high temperatures. The higher temperature affects the reproductive growth adversely by increasing flower abortion and decreasing seed size (Talwar et al. 1999).

Shelling Percentage and Harvest Index (HI)

Rainy Season

The values for shelling percentage and harvest index are presented in Table 3.1. Shelling percentage was significantly affected by groundnut variety. Sinpadaethar 7 produced the highest value (75.27%), which was significantly higher than that of Sinpadaethar 8 (72.07%). Seed sizes did not significantly affect on shelling percentage. Among the varieties, Sinpadaethar 7 had the greatest harvest index (0.51) and this was significantly higher than the harvest index of other varieties. Harvest index was not influenced by seed sizes. Duangpatra and Wongmajarrensin (1993) reported that no effects of seed sizes were observed on shelling percentage and harvest index.

Winter Season

Sinpadaethar 7 produced the highest shelling percentage (70.34%), but it was not significantly different from other varieties (Table 3.2). Seed size did not significantly affect shelling percentage. The highest shelling percentage was resulted from large (70.60%) seed size. Maximum harvest index (0.62) was obtained from Sinpadaethar 7 and it was not significantly different from other three varieties. Mean harvest index as affected by different seed sizes was not significantly different. Large seed sizes produced the maximum harvest index (0.56) followed by small (0.53) and medium (0.51) seed size. Martinson (2009) stated that seed size did not affect shelling percentage and harvest index. Shelling percentage had positive association with number of pods per plant (Swamy Rao et al. 1988). Ramadevi and Rama Rao (2005) observed that higher harvest index in plants from bold seed might be due to more partitioning of dry matter towards pods.

Oil and Protein Content

Oil and protein contents were important quality traits for groundnut. They were negatively correlated with each other (Dwivedi et al. 1990). The values of oil and protein contents of different seed sizes and varieties of groundnut are presented in Table 4.1 for rainy season and Table 4.2 for winter season. For varieties, the highest oil content was resulted from Sinpadaethar 7 in both rainy and winter seasons. The highest protein content was obtained from Sinpadaethar 9 in rainy season and from Magway 15 in winter season. The values of oil content and protein contents were slightly different among seed sizes in both seasons. Therefore, the differences in oil and protein contents did not concern with difference in seed sizes. It may be due to the effect of genotypes and environmental factors (Mulalic 1969). Holley and Hammons (1968) observed an increase in total oil and a decrease in total protein in wet years (non-stressed). Differences in oil content became significant only under moderate to intense water deficit. In contrast, differences in protein became significant even at relatively low levels of moisture deficit (Dwivedi et al. 1996). The time of planting also influences the protein and oil contents of seeds. Mulalic (1969) observed that changes in the protein and oil levels in the seed, brought about by

delayed planting and season of planting could be attributed to changing temperature and sunshine levels. High ambient temperature and prolonged sunshine affected seed filling stage and increased protein content.

Conclusions and Outlook

The effects of groundnut varieties on the yield and other related characters were found to be obvious and significant. The higher pod yield, number of pods per plant, shelling percentage, harvest index, and oil content were observed to be highest in Sinpadaethar 7, and this variety should be recommended to be applied for effective production in terms of pod yield in rainy and winter seasons. The highest protein content was observed in Sinpadaethar 9 and Magway 15 in rainy and winter season, respectively. The effects of size of planting seeds on yield and growth characters were not as obvious as that of variety. The plants from large seeds indicated faster growth rate, especially in the initial growth stage as expressed in higher mean values of plant height, crop growth rate and harvest index in both season. At later growth stages, no significant differences were observed for the above parameters. Oil and protein contents were slightly affected by seed size. Based on the findings of this study on the effect of seed size on yield, it can be recommended that the smaller seeds can be used as the seed stock for groundnut growers whereas medium and large seeds were used for their income.

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