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EFFECT OF SEED SETT WEIGHT OF GINGER (*ZINGIBER OFFICINALE*) ON YIELD

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ABSTRACT : Six weight ranges of ginger seed setts (14 to 28 g, 29 to 43 g, 44 to 57 g, 58 to 85 g, 86 to 114 g, and 115 to 128 g) were evaluated for yield in Gurabo, east-central Puerto Rico. The soil in the experimental area is of the Mabí clay series (fine, montmorillonitic, isohyperthermic Vertic Eutropepts). Rainfall during the nine-month cycle of the ginger (March-December 2005) was 1,744 mm (68.6 in); drip irrigation was also provided on a regular basis. No significant differences in yield were found between the two heaviest seed sett weight ranges used for planting, 115 to 128 g and 86 to 114 g. The 115- to 128-g setts yielded higher (α=0.05) than the four remaining ranges. The average yield of the 115- to 128-g setts was 24.59 mt/ha, whereas that of the 86- to 114-g setts was 18.47 mt/ha. The 86- to 114-g setts yielded significantly higher than the 14- to 28-g or the 29- to 43-g setts. Results indicate that the seed sett weight range of 86- to 114-g is the most feasible weight for planting ginger in east-central Puerto Rico.

RESUMEN: Se evaluaron seis rangos en peso de material de propagación de jengibre (14 a 28 g, 29 a 43 g, 44 a 57 g, 58 a 85 g, 86 a 114 g y 115 a 128 g) en relación al rendimiento total del cultivo en Gurabo, en la zona central-este de Puerto Rico. El suelo en el área del experimento es de la serie Mabí arcilloso (fine, montmorillonitic, isohyperthermic Vertic Eutropepts). La pluviometría durante el ciclo de crecimiento del jengibre (marzo-diciembre 2005) fue de 1,744 mm (68.6") y se suplió riego suplementario por goteo regularmente. No se encontraron diferencias en rendimiento entre los dos rangos de mayor peso (115 a 128 g y 86 a 114 g) del material de propagación. El rango de peso de 115 a 128 g del material de propagación rindió más (α = 0.05) que los otros cuatro rangos de peso. El rendimiento promedio del material de propagación del rango en peso de 115 a 128 g fue de 24.59 tm/ha, mientras que el rendimiento del rango de 86 a 114 g fue de 18.47 tm/ha. El tratamiento de rango en peso del material de propagación de 86 a 114 g resultó significativamente mayor al de los rangos de 14 a 28 g y del de 29 a 43 g. Los resultados indican que el peso más factible para la siembra del material de propagación de jengibre en la zona central-este de Puerto Rico es de entre 86 y 114 g.

INTRODUCTION

Ginger is an important commodity in both the Caribbean and Pacific Basins. In Hawaii, production of 8.2 thousand metric tons was achieved in 1997-98. In the 2005-2006 season, 1.95 thousand metric tons were produced on 40 ha, with a value of $3.01 million at the farm gate (Hawaii Department of Agriculture).

In Jamaica, the highest exports of ginger were achieved in 1953, when two thousand metric tons of rhizomes were exported. Every year between 1881 and 1968, Jamaican exports surpassed 455 metric tons (one million pounds). In 1997, Chung (1998) reported that 466 metric tons of ginger were produced in Jamaica.

Ginger is well adapted to Puerto Rico. It is a component of the crop diversification effort of the island. It is a high value commodity that serves as an alternative crop to the farmers of central Puerto Rico.

Ginger rhizomes harvested at the farm are either sold to generate income or used for planting a subsequent crop. Whiley (1981) reports that the weight of the planting material in Queenland, Australia, ranges between 4 and 6 mt/ha, although seeding rates of up to 10 mt/ha appear to be an economical proposition. The propagating material (rhizome sections) used for planting range from 50 to 80 g.

Several authors have conducted research to determine the optimum weight of ginger seed setts under their edaphic and climatic conditions. Whiley (1981) compared seed setts of two weights (42.5 and 85.5 g) at three planting distances. He found that at maturity (nine months after planting) the heavier seed setts yielded significantly more and produced a higher knob size than the lighter ones.

Okwuowulu (1998) compared ginger setts ranging in weight from 5 to 40 g of two cultivars (bold yellow and black). He found that yield increased as the weight of the sett increased. The yield of the 5-g setts was 14.1 t/ha; the yield of the 20 g setts was 25.2 t/ha; and that of the 40 g setts, 36.6 t/ha.

Sanewski et al. (1996) report that in Australia, planting setts of 20- to 30-g resulted in fewer shoots than when 40- to 50-g or 60- to 70-g setts were used. They also found a strong correlation between the number of shoots and yield. Evenson et al. (1978) reported that the optimum temperature for sprouting ginger ranges from 25° C to 30° C.

The objective of this research was to determine the optimum seed setts weights of ginger in the central valley of eastern Puerto Rico.

MATERIALS AND METHODS

Ginger rhizomes were harvested on 2 March 2005, from a private farm in Barranquitas and taken to the Gurabo Agricultural Experiment Station, where they were spread on a cement floor under shade in a well ventilated area. Two days later, the rhizomes were treated by immersion for 10 minutes in a solution containing 8 ml/L of oxamyl, 2 ml/L of metalaxyl, and a tablespoon of copper sulfate. On 11 March 2006, the rhizomes were cut into the six weight ranges that made up the treatments of the experiment: 1) 14 to 28 g; 2) 29 to 43 g; 3) 44 to 57 g; 4) 58 to 85 g; 5) 86 to 114 g; and 6) 115 to 128 g.

The experiment had a random block statistical design with six treatments and five replications. Each plot consisted of five beds, 0.76 m apart and 6 m long. Rhizome pieces were spaced 30.4 cm apart and planted in single rows on top of the bed. Each plot consisted of 100 plants in an area of 23.2 square meters. The ginger rhizome sections were planted in the field on 16 March 2005. A drip irrigation system was installed for the experiment, and the first irrigation occurred at the conclusion of the planting. Irrigation was provided when needed.

The soil in the experiment is a fine montmorillonitic isohyperthermic Vertic Eutropepts of the Mabí clay soil series. The experiment was fertilized twice, at seven weeks and at six months after planting. The first application was a 12-5-15-3 formula with one percent micronutrient mix to supply 67 kg/ha N, 28 kg/ha P_2O_5, 84 kg/ha K_2O and 17 kg/ha MgO. The second application supplied 67 kg/ha N and 90 kg/ha K_2O.

The experimental area had had a severe infestation of purple nutsedge (*Cyperus rotundus*) during the previous years. To reduce the population of this and other weeds,

glyphosate at 2.4% was applied before crop emergence at two weeks after planting. A directed spray of glyphosate at 2.4% was repeated at five weeks after planting. Ametryn at 4.4 kg/ha was also applied at five weeks after planting and at 2.2 kg/ha at 10 weeks after planting as a directed spray. Hand weeding operations were carried out at seven and 10 weeks after planting and thereafter as needed. The application of endosulfan at six and eight weeks after planting was made to control cutting insects.

Three months after planting, leaf streak symptoms began to appear in the plants. Kocide at 6.5 g/L was applied alternately with chlorothalonil at 8 ml/L on a weekly basis from 9 August to 14 October 2005. Sprouts per plot were counted at 10 weeks after planting. The experiment was harvested at nine months after planting on 19 December 2005. Only the three center rows of each plot (60 plants in 13.9m^2) were weighed for yield.

RESULTS AND DISCUSSION

Sprouting

The number of sprouts per treatment taken at 10 weeks after planting increased steadily from the lighter seed sett weights to the heaviest weight (Table 1). The 14- to 28-g sett range treatment produced an average of 544 sprouts, the 29- to 43-g setts had 664, the 44- to 57-g setts had 800, the 58- to 85-g setts had 898, the 86- to 114-g setts had 1032 and the 115- to 128-g setts had 1,223 sprouts. The results demonstrate that for the six ginger sett weights studied, the higher the sett weight, the higher the number of sprouts.

Yield

The average yield of ginger rhizomes at nine months after planting is shown in Table 2. The average yield in the experiment ranged from 7.49 mt/ha in the treatment with the lightest seed sett weight (14 to 28 g) to 24.59 mt/ha in the treatment with the heaviest seed sett weight (115 to 128 g).

The average yield of the 29- to 43-g sett range was 10.73 mt/ha, of the 44- to 57-g sett range was 17.01 mt/ha, of the 58- to 85-g sett was 15.36 mt/ha and of the 86- to 114-g sett range was 18.47 mt/ha. Results of a Duncan's multiple range test at $\alpha = 0.05$ indicate that there were no significant differences in average yield of ginger rhizomes between the two heaviest seed sett ranges of 86 to 114 g and of 115 to 128 g.

The heaviest weight range studied (115 to 128 g) yielded higher than the four lightest weight ranges (14 to 28 g, 29 to 43 g, 44 to 57 g and 58 to 85 g). The 86- to 114-g range yielded higher than the 14- to 28-g and the 29- to 43-g ranges. However, no differences were found between the 86-to 114-g range and the 44- to 57-g and the 58- to 85-g ranges. Results indicate that ginger seed sett weight ranging from 86 to 114 g should be used for planting ginger in east-central Puerto Rico.

A hectare of ginger, at the plant spacing used for the experiment would have a population of 43,290 plants. The average weight of the seed setts in the 86- to 114-g range is 100 g. The number of plants times the average sett weight (43,290 plants x 100 g) is 4,329,000 g, or 4,329 kilograms. If the heavier seed sett weight (115- to 128-g), averaging 121.5 g is used for planting, 5,260 kilograms of seed setts would be necessary to plant one hectare. The savings in the use of planting material would amount to 931 kg (5,260 - 4,329 = 931) when using the 86- to 114-g range for planting, rather than the 115- to 128-g range.

Since no differences in ginger yield were found between the 86- to 114-g range and the 115- to 128-g range, and since a savings of 931 kg would be made by using the lighter seed setts, on the basis of the conditions and results of the experiment, seed setts of 86- to 114-g weight should be used for planting ginger.

Table 1. Number of sprouts per treatment (five replications, 30.5 m^2) at ten weeks after planting

Treatment Seed Sett Weight (g)	Number of Sprouts
14 to 28	544
29 to 43	664
44 to 57	800
58 to 85	898
86 to 114	1032
115 to 128	1223

Table 2. Total yield of ginger rhizomes per treatment in a seed sett weight experiment at Gurabo, Puerto Rico, 2005

Treatment Seed Sett Weight Range	Total Yield
g	mt/ha
14 to 28	7.49 a
29 to 43	10.73 ab
44 to 57	17.01 bc
58 to 85	15.36 bc
86 to 114	18.47 cd
115 to 128	24.59 d

Duncan's multiple range test ($\alpha = 0.05$)

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