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Agroproductive Evaluation of Maize (*Zea mays* L) and Beans (*Phaseolus vulgaris* iL.) Cultivated in Association, in Angonia, Mozambique

Yaima de las Mercedes Daniel Ortega [1], Sérgio Pascoal Fidélis Abel Meireles [2], Armando del Busto Concepción [3] & Lorenzo Donis Garcia[4]

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ABSTRACT

This research took place at the Center for Agricultural Research in Mozambique, on red ferrallitic soil, located at the Ntengo Umodzi Agronomy Post, Angonia District, Province of Tete, in 2012-2012. The aim was to evaluate agroproductivity indicators within a crop area of maize and beans in association. A randomized block experimental design was used, with 4 replicas and 5 treatments, consisting of maize plants, variety PAN 53; and beans, variety Diacol, in association, in 20 lots of 8 furrows each. Plant height was evaluated for the two crops. The number of kernels per ear and beans per pod were determined, along with the land equivalence ratio. SPSS 13.0 for Windows was used for statistical analysis of results, and normal distribution of each variable data was checked. Variance analysis was made as well. The Pearson correlation coefficient was performed through the Statistical Analysis System (SAS). The results showed no significant differences in terms of plant height and number of kernels per ears. The land equivalence ratio of the associated area was efficient for all the bean treatments, with a 61% advantage over mono-crops.

KEY WORDS/: intercropping, *Zea mays*, *Phaseolus vulgaris*, maize, beans, equivalence ratio

INTRODUCTION

Crop association or intercropping system is the plantation of different species in the same area so that a given crop exists along with others, during the whole, or part of its cycle (Portes & Silva, 1998) (Rezende, Canato & Cecilio, 2002).

Intercropping can reduce the growth of harmful plants. This practice is carried out by small farmers who seek to reduce loss risks of unstable climate, better land use, and greater income. It is a reliable alternative to increase food supplies (Andrade *et al*., 2001).

Because of limited crop land area and poor field conditions, the farmers´ goal is to make better use of the available space and resources by associating crops, particularly maize and beans.

In developing countries, like Mozambique, maize and bean associations are critical; these crops are supplied as basic foods to low income people.

This production technique is applied in Mozambique at a small scale, from the north to the south, with the highest preponderance in the central part of the country. It has been done empirically by most farmers with few lands, capital, and technology.

[1] Professor, Ignacio Agramonte Loynaz University, Camagüey, Cuba. yaima.daniel@reduc.edu.cu
[2] Professor, University of Zambeze (UNIZAMBEZE), Chimoio, Mozambique. sergiomeireles2@gmail.com
[3] Professor, Hermanos Saiz Montes de Oca University (UPR), Pinar del Rio, Cuba. armando@upr.edu.cu
[4] Professor, Máximo Gómez Báez University, (UNICA), Ciego de Ávila, Cuba. lorenzodonisgarcia@gmail.com

Therefore, the country still applies mono-crop systems almost entirely. Mono-crop is linked to intensive use of agrotoxic substances to control pests with chemicals (Gliessman, 200), affecting the agroproductive qualities, and increasing the production costs, risks of greater crop losses, higher incidence of harmful plants, and smaller land equivalence ratio than for intercropping systems. The aim of this study was to prove the importance of associated systems as a strategy to strengthen sustainable agriculture in Angonia. Hence, it was important to demonstrate the agroproductive importance of intercropping systems for these crops to prevent losses caused by the climate, pests, and diseases. The general goal was: To determine the agroproductive indicators of a maize-bean intercropping system.

MATERIALS AND METHODS

This research took place at the Center for Agricultural Research in Mozambique (IIAM), located at the Ntengo Umodzi Agronomy Post, Angonia District, Province of Tete, in 2012-2013. It was made on heavy, deep and moderately well drained (slightly-heavy lixiviated) red-brown ferrallitic soil, with great capacity for water retention (Direcção Nacional de Administração Local, 2005).

The climate was temperate humid, and strongly influenced by altitude. The precipitations varied from one season to another, 725 mm-1149 mm, with 90% occurring between late November and early April. Soil tilling was made using plow and disk harrows. Maize was sown on December 14, 2012, by hand, using a hoe. Two seeds were placed per hole, and thinning out was made 12 days later. Harvest took place on May 18, 2013. Bean sowing was made on December 14, 2012, and harvest took place on January 4, 2013. The bean pods and corn ears emerged on December 20, 2013.

Weeds were controlled by hand labor. No chemicals were applied for pest control. The treatments used for the investigation were for maize variety Pan 53, and bean variety Diacol Calima, arranged in eight furrows per lot, with five different treatments.

Treatment (A): 100% maize was sown at a distance of 0.70 m x 0.20 m.
Treatment (B): 100% beans was sown at a distance of 0.70 x 0.05 m.
Treatment (C): 25% maize, and 75% beans were sown in association (0.70 m x 0.2 m x 0.70 m and 0.05 m).
Treatment (D): 50% maize and beans were sown at the same distance as previously stated.
Treatment (E): 75% maize, and 25% beans were sown in association, at the same distance previously stated.
A randomized block experimental design was used, with four replicas and five treatments, consisting in a combination of maize plants, variety PAN 53, and beans, variety Diacol, in 20 lots of 8 furrows each. The distance between furrows was 0.70 m, with a length of 8 meters, and 5.6 m width, in each lot.

Plant height was evaluated for both plants. Accordingly, to determine the maize plant height, 15 plants were measured (from the soil level to the insertion of the top leaf). Measurements of bean

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plants were made between the soil level and the insertion of the top branch of the low plant and the insertion of the top branch.

The yield parameters were determined for the two plants. Plant height was evaluated for the two crops.

In maize, the number of kernels per ear was determined by counting all the kernels of 20 plants. In beans, the number of grains per pod was calculated by the ratio between the total number of grains, and the total number of pods, from previously chosen plants.

The land equivalent ration (LER) was calculated, and then used to evaluate the efficiency of the association in comparison to the mono-crop, through LER = (Mc/Mm) + (Bc/Bm) where Mc and Bc are the kernel and bean yields, respectively, of the intercropping systems. Mm and Mc are the kernel and bean yields, respectively, in both mono-crops (Miley, 1979). The association was considered efficient when the LER was greater than 1.00; and inefficient, when it was below 1.00. LER was used for evaluation of the biological efficacy of the systems for equivalent maize production.

SPSS 13.0 for Windows was used for statistical analysis of results, and normal distribution of each variable data was checked. Variance analysis was made as well. The Pearson correlation coefficient was performed through Statistical Analysis System (SAS) to analyze the yield component values, with a 5% error probability.

RESULTS AND DISCUSSION

Maize

Table 1. Plant height (cm) in the different treatments

Treatments	Plant height (cm)
A (100% maize).	202[a]
C (25 % maize and 75% beans, in association)	190[a]
D (50 % maize and beans, in association)	190[a]
E (75% maize and 25% beans, in association)	204[a]
ESx	3.29

The behavior of plant height was similar, with no significant differences in all the treatments, in relation to the spatial arrangement of the experiment. Table 1 shows the average height results for maize harvested at the end of the crop cycle.

The tendency for group (E) was 204.0 cm high. No apical dominance trend was found as a consequence of plant competition over light, so the different spatial arrangements did not limit exposure to light; hence, plant growth was not affected. The results of the research were similar to the ones achieved by Frank (2011), who made experimental evaluation of season varieties to identify the most stable varieties, with 197.0 cm high.

Studies made by Fornsieri (2007), Sangoi (2000), and Fioreze *et al.* (2007), attributed it to a better distribution of plants in the area, increasing the efficiency of solar radiation, water, and nutrients, as well as better weed control, due to faster closure of the gaps between plants, and lower solar radiation on the soil surface. Generally, the higher plant density, the greater plant height was greater, thanks to intraspecific competition over light, and the resulting stimulation of apical dominance of the plants.

Table 2 Number of kernels per ear in the different treatment (one)

Treatments	Number of kernels per ear
A (100% maize).	567[a]
C (25 % maize and 75% beans, in association)	525[a]
D (50 % maize and beans, in association)	510[a]
E (75% maize and 25% beans, in association)	483[a]
ESx	9.6

In comparison to table 2, the results showed no significant differences among the treatments. The number of kernels per ear in the different treatments are shown with mean values of 567 kernels per ear in treatment (A), and 483 kernels per ear in treatment (E). This parameter was related to the kind of plant arrangement in the area, stimulating competition over natural resources, like water, light, and nutrients. According to Matoso (2011), the study of cultivated maize and beans in stripes, had average values of 406.0 - 486.2 kernels per ear, with no significant effects on hybrid maize. Sangoi *et al.* (2002a) pointed that with the increase in plant density per ha, interception of solar radiation by maize was maximized; however, it favored female sterility, and increased intervals among antenises with related reduction in the number of kernels per ear. Penariol (2003), noted that the distance between the furrows did not affect the number of kernels per ear.

Table 3. Maize yields

Treatments	Yields t/ha
A (100% maize).	8.55[a]
C (25 % maize and 75% beans, in association)	7.7[a]
D (50 % maize and beans, in association)	7.1[a]
E (75% maize and 25% beans, in association)	6.9[a]
ESx	0.41

Variance analysis revealed that the behavior of yields in the treatments had no significant differences ($p > 0.05$). Table 3 shows the yield averages in treatment (A) was 8.55 t/ha, and treatment (C) 7.7 t/ha. This value was linked to greater plant density and arrangement in mono-crop systems, which contributed to production increase. Senasem (2008), achieved yields of about 6.0 to 8.0 t/ha, and Frank (2011) made experimental evaluations of different season varieties to identify the most stable variety, with yields of 5.2 - 8.7 t/ha.

Maciel *et al.* (2004) made an important contribution to the assertion that the agronomical characteristics of maize have higher values with the highest density of plants per hectare. Thus, to increase yields in intercropping systems, the main crop should maintain a high population density (Flesch, 2002). According to Sangoi (2000), Argenta *et al.* (2001a) and Denega *et al*. (2004), besides the genetic factors, the soil and climate conditions (solar radiation that activates photosynthesis) have a significant negative effect. The intake of light is the most important process to foster yields.

Beans

Table 4. Plant height in the different treatments

Treatments	Plant height (cm)
B (100% beans)	28.9[a]
C (25% maize and 75% beans, in association)	27.0a
D (50% maize and beans, in association)	27.8[a]
E (75% maize and 25% beans, in association)	27.0[a]
ESx	0.44

Table 4 shows the results of statistical analysis of plant height which did not have significant differences. It occurred thanks to optimal light, water, and nutrient distribution in the system. The mean values for treatment (B) were 28.9 cm, whereas treatment (C) had mean values of 27.0 cm. The greatest average height of the maize plants may have provided a wider shade area on the bean rows, which had a negative influence on the establishment of bean plants, since their growth

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is determined. Similar results (Oliveira, 2011) revealed important similarities in the heights of different treatments, and reported proper distribution of the environmental factors.

Radosevich & Holt (1984) considered that the physical arrangement of foliage is a key factor to plant development in terms of competition over light; the position of leaves on a plant in relation to others was especially important. According to Kozlowski (1999), when two or more plants are grown together, their roots overlap and penetrate the soil, and their foliage produces shade in areas where higher plants are more efficient.

Competition over light owed to the favorable position of leaves in relation to light interception. The most efficient plants in light competition are the highest and more capable to position their leaves and capture more light from the adjacent plants during the initial stage of growth. Shading over lower plants caused by the higher plants is the main reason why plants compete over light (Anderson, 1983).

In turn, plant height is considered a growth parameter for crops, and it can be determined by measuring the vertical distance between the soil surface and the spot of the last inserted leaf, with a centimeter ruler (Sa, M & Sobrinho, 1994)

Table 5 Number of beans per pod in the different treatments

Treatments	Number of beans
B (100% beans)	3.5^{b}
C (25% maize and 75% beans, in association)	3.3^{a}
D (50% maize and beans, in association)	3.4^{a}
E (75% maize and 25% beans, in association)	3.6^{a}
ESx	0.45

Table 5 shows a statistically significant difference for the number of beans per pod in treatment (B). The number of beans per pod in the different treatments had mean values of 3.5 beans per pod in treatment (B). Similar results were achieved by (Carvalho & Wanderley, 2007) who evaluated bean varieties and reported 3.1 to 3.5 beans per pod, with a mean of 3.3 beans per pod.

Andrade (1998) noted that this variable shares high genetic heredity, and are less influenced by the environment. Besides, this feature has not been linked to general productivity. Maciel (2004) justified the fact that the number of seeds per pod withstand little interference from the association thanks to these innate traits of the variety, thus receiving little interference form the environment. According to Souza *et al.* (2005); (Costa & Silva, 2008), there was no significant difference that can be attributed to the associated systems used.

Table 6 Bean yields

Treatments	Number of beans
B (100% beans)	1.2[a]
C (25% maize and 75% beans, in association)	1.1[a]
D (50% maize and beans, in association)	0.8[a]
E (75% maize and 25% beans, in association)	0.9[a]
ESx	0.21

Table 6 shows the values that underwent statistical variance analysis, with no significant differences in the different treatments. Bean yields in treatment (B) was 1.2 kg/ha, followed by treatment (C), with 1.1 kg/ha. These yields could be justified by the fact that this crop system had a larger population than the rest. These results were similar to reports by Vieira *et al.* (2008), who studied the effects of doses of nitrogen and molybdenum on bean; the Diacol Calima yields were (726) 1.5 kg/ha. Vieira *et al*. (2008) studied yields of different bean varieties, and reported 1.6 kg/ha for this variety.

Research done by Carvalho & Wanderley (2007) evaluated bean varieties with average yields of 1.5 kg/ha, for Diacol Calima. Flesch (2002) and (Costa & Silva, 2008) observed that the association consisting of one furrow of maize and two furrows of beans had higher yields. They concluded that a reduction in bean yields was linked to closer furrows of maize and bean. In beans, yields depend on several factors: selected seeds, varieties, climate, and chemical and physical features of the soil (Rezende, 2007).

Land Equivalence Ratio (LER)

The LER revealed that the association was efficient for all maize and bean treatments. The mean for all the treatments was 1.61, which indicated that for mono-crops to produce the same amount of foods in 1 hectare of intercropping, it would take 0.83 ha of maize, and 0.78 ha of beans, totaling 1.61 hectares (Table 7). The association system had 61% advantage over mono-crops in terms of area use efficiency. The highest LER for the treatments was 1.79, in treatment (C); it permitted better area use. The least favorable treatment was (E), with 1.50. The results of the experiment corroborated the results of Raposo *et al*. (1995), who evaluated maize-bean intercropping, with different plantation schemes and plant populations, where the association systems proved their superiority, based on LER.
Morgado & Willey (2003) evaluated the effect of bean plant populations in association with maize, and demonstrated the efficacy of intercropping, based on the LER values of ear and biomass production, in comparison to mono-crops. Santos (2007) studied maize-bean intercropping for two agricultural seasons, and achieved LER values of 1.19-1.83, depending on the combination of maize and bean varieties.

Table 7 LER values in all the treatments

Treatments in association	Partial maize LER	Partial bean LER	Total LER
C	0.89	0.90	1.79
D	0.82	0.72	1.54
E	0.79	0.71	1.50
Mean	0.83	0.78	1.61

* C (25% Maize/75% Beans); D (50% Maize/Beans); E (75% Maize/25% Beans)

The superiority of intercropping estimated by LER was also observed by several researchers, like, Aidar *et al*. (1979); Garcia & Pinchinat (1976); Wijesinha *et al*. (1982), who demonstrated the advantages of intercropping systems based on LER.

The intercropping systems are more efficient and greater land area use. Evaluation of intercropping efficiency in comparison to mono-crops based on LER is often made. It equals the number of one hectare used for mono-crops to one hectare of the same crop in association with another crop (Vieira, 1984).

Moreover, an intercropping area yields greater amounts of grains than the same area used in mono-crops. It is critically important for small farmers. Vieira (1985); Oliveira & Silva (2001) claimed that to validate LER, it is important to assess it along with the yields achieved. Therefore, it is important to note that small farmers associate maize and bean, aiming to harvest the latter crop as a surplus, without harming or risking productivity (Santos, 2007).

CONCLUSIONS

No significant differences were observed for plant height and growth in both crops. Regarding the number of kernels per ears, treatment (A) had the largest value (567). In beans, treatment (B) had more beans per pod (3.5).

The highest yields in maize were observed in treatment (A), totaling 8.55 t/ha; whereas the highest yields for beans were observed in treatment (B), with 1.2 t/ha. The maize-bean association provided a greater land equivalence ratio (1.61).

REFERENCES

Aidar, H., Vieira, C., Oliveira, L. M., & Vieira, M. (1979). Cultura associada de feijão e milho.Efeito de populações de plantas no sistema de plantiosimultâneo. *Ceres, 26*(143), 102-111.

Anderson, W. P. (1983). *Principies.* Minnesota: St. Paul,.

Andrade, B., Morais, A. R., Teixeira, I. R., & Silva, M. V. (2001). Avaliação de sistemas de consórcio de feijão com milho-pipoca. (Lavras, Ed.) Ciência Agrotécnica, 25, 242-250.

Andrade, M. J (1998). Resposta da cultura do feijoeiro à aplicação foliar de molibdênio e às adubações nitrogenadas de plantio e cobertura. (Lavras, Ed.) Ciência e Agrotecnologia, 22(214), 499-508.

Carvalho, M. A. (2004). Produtividade do milho em sucessão a adubos verdes no sistema de plantio directo e convencional. *Pesquisa Agropecuária Brasileira, 39*(1), 47-53.

Carvalho, W. P., & Wanderley, A. L. (2007). Avaliação de cultivares de feijão comum para o plantio em sistema orgânico no cerrado. *23*(3), 50-59.

Costa, A. S., & Silva, M. B (2008). Sistemas de consórcio milho feijão para a região do vale do rio doce, Minas Gerais. Ciência Agrotécnica, 32(2), 663-667.

Denega, S., Jadoski, S. O., & Mallmann, N. (2004). Avaliação da produtividade no consórcio de milho e feijão. *Guairacá, Guarapuava, 20*, 17-31.

Direcção Nacional de Administração Local. (2005). *Perfil do distrito de Angónia.* Angonia, Tete: Mninisterio da Administração Estatal.

Flesch, R. D. (2002). Efeitos temporais e espaciais no consórcio intercalar de milho e feijão. *Pesquisa Agropecuária Brasileira, 37*(1), 51- 56.

Fioreze, S. L., Guimarães, V. F., Marchi, S. L., Pivetta, L. G., Fano, A., & Machado, F. R. (2007). Resposta do milho (Zea Mays L.) a diferentes níveis deadubação de base em cultivos anteriores e arranjos espaciais de plantas. *In: Congresso Brasileiro de Ciência do Solo* . Anais, Gramado-RS.

Fornasieri, F. D. (2007). *Manual da cultura do milho.* Funep.Jaboticabal.

Franck, D. C. (2011). *Evolution of experimental varietes on station to identify superior stable yielding varietes. Maize improvement – CSIRCRI.* Guinea Savannah: Coastal savannah and transition zonas of Ghana.

Garcia, J., & Pinchinat, A. M (1976). Producción associada de maiz e soya a diferentes densidades de siembra. Turrialba, 26(4), 409 411.

Gliessman, R. S. (2000). *Agroecologia: processos ecológicos em agricultura sustentável.* Porto Alegre.

Kozlowski, A. L. (1999). *Período crítico de interferência das plantas daninhas na cultura do feijoeiro-comum em sistema de semeadura direta.* Dissertação apresentada como requisito parcial para a obtenção do título de "Mestre em Ciências", Curitiba.

Maciel, A. D. (2004). Comportamento do feijoeiro em cultivo consorciado com milho em sistema de plantio direto. *Acta Scientiarum Agronomy, 26*(3), 273 278.

Maciel, A. D., Silva, M. G., Arf, O., Sa, M. E., Buzetti, S., Andrade, J. A., et al. (2004). Comportamento do milho consorciado com feijão em sistema de plantio direto. *Acta Scientiarum Agronomy*, *26*, 309 314.

Morgado, B. L., & Willey, R. W. (2003). Effects of plant population and nitrogen fertilizer on yield and efficiency of mayze-bean intercropping. *Pesquisa Agropecuária Brasileira, 38*(11), 1257 1264.

Oliveira, & Silva, L. O. (2001). Cultura associada de feijão e milho.XIII-Retardamento de plantio em uma ou outra das culturas. *Revista Ceres, 48*(8), 583 592.

Oliveira, M. A. (2011). *Milho e feijão-caupi cultivados em faixas na safrinha.* Dissertação apresentada à Faculdade de Ciências Agronômicas da UNESP Campus de Botucatu, para obtenção do título de Mestre em Agronomia, BOTUCATU-SP.

Penariol, F. G. (2003). Comportamento de cultivares de milho semeadas em diferentes espaçamentos entre linhas e densidades populacionais na safrinha. *Revista Brasileira de Milho e Sorgo, 2*(2), 52 60.

Portes, T., & Silva , C. C. (1998). Cultivo consorciado. *Cultura do feijoeiro comum no Brasil.*, 415 437.

Radosevich, S. R., & Holt, J. S. (1984). *Weed Ecology: Implications for vegetation management.* New York: John Wiley Sons.

Raposo, A. J., Schuch, F. N., & Machado, A. A. (1995). Consorcio de milho e feijao em diferentes arranjos e populacoes de plantas, em Pelotas. *Pesquisa. Agropecuaria, 30*(5), 639 647.

Rezende, A. B., Canato, G. H., & Cecilio, F. A. (2002). *Produtividades das culturas de tomate e alface em função da época de estabelecimento do consórcio, em relação a seus monocultivos, no cultivo de inverno.* Congresso Brasileiro de Olericultura , Uberlândia.

Rezende, R. (2007). Função de produção da cultura do milho e do feijão para diferentes lâminas e uniformidade de aplicação de água. *Acta Scientiarum Agronomy, 26*(4), 503 511.

Sa , M. d., M, A. O., & Sobrinho, F. S. (1994). Comunicação: Aspectos morfológicos e fisiológicos de cultivares moderna e antigas de milho. *Ciência e Agrotecnologia., 26*(5), 1082 1091.

Sangoi, L. (2000). Understanding plant density effects on maize growth and development: an important issue to maximize grain yield. *Ciência Rural, 31*(1), 159 168.

Sangoi, L., Almeida, M. L., Gracietti, M. A., Bianchet, P., & Horn, D. (2002). Sustentabilidade do colmo em híbridos de milho de diferentes épocas de cultivo em função da densidade de plantas. *Revista Brasileira de Milho e Sorgo, Sete Lagoas, 1*(3), 47 58.

Santos, N. C. (2007). *Comportamento de cultivares de feijoeiro e de milho verde em cultivo solteiro e consorciado.* Tese (Doutorado em Agronomia).

Senasem. (2008). *Politique natinale du developpment du sous secteur de semences.* Kinshasa: Minagri.

Souza, F. F., da Silva, A. G., de Souza, E. B., Neves, L. R., Faria, L. C., & Del Peloso, M. J (2005). Desempenho de genótipos de feijão-comum avaliados em Porto Velho, na safra 2003/2004. Comunicado técnico, Porto velho.

Souza, M. d., Tavora, F. A., Bleicher, E., & Pitombeira, J. B (2002). Efeito do consórcio do milho (Zea mays L.) com o feijãode-corda (Vigna unguiculata (L.) Walp.) no rendimento de grãos, uso eficiente da terra e ocorrência de pragas . Ciência Agronômica, 35.

Souza, M. d., Tavora, F. A., Bleicher, E., & Pitombeira, J. B (2002). Efeito do consórcio do milho (Zea mays L.) com o feijãode-corda (Vigna unguiculata (L.) Walp.) no rendimento de grãos, uso eficiente da terra e ocorrência de pragas . Ciência Agronômica, 35.

Vieira, C. (1984). *Índice de equivalência de área.* Informe Agropecuário, Belo Horizonte.

Vieira, C. (1985). *O feijão em cultivos consorciados.* Viçosa.

Vieira, R. F., Lima, R., & Cardoso, L. (2008). Desempenho de cultivares de feijão-arroz em Coimbra e Leopoldina. *Ceres*.

Vieira, R. F., Vieira, C., Fondeca, J. R., Moura, W. M., & Rigueira, C. M (2002). Comportamento de variedades de feijão do tipo jalo em minas gerais II. Ceres.

Wijesinha, A., Federer, W. T., Carvalho, J. R., & Portes, T. A. (1982). Some statistical analysis for a maize and beans intercroping experiment. *Crop Science, 22*(3), 660 666.