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Research Application Summary

Evaluation of performance of soyabean under farmers specific biophysical and social environment

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Abstract

An on farm study was conducted in Kasungu at Mkanakhoti and Kandeu Extension Planning Areas in Malawi to investigate the effect of multi-environment (biophysical and social economic) factors on performance of soybean. The community was sensitized after which, farmers to host the trials were purposively sampled. A total of 100 farmers were selected. The experiment was laid out in a randomized block design, with each farmer considered a replicate. Experimental plots measured 10 m by 10 m, and on average acommodated 14 ridges. Soybean seed was inoculated with *Bradyrhizobium japonicum* following a procedure outlined by Ministry of Agriculture, Irrigation and Food Security. Ocepara 4 (soybean variety) was planted in double rows at a spacing of 0.25 x 0.005m. Sets of double rows were 0.75 m apart. The questionnaire was used to collect socio-economic data, plot management and cropping history. Soil texture and soil pH were determined following standard procedures. Majority (64%) of the farmers had attained primary education. Soils were mostly sandy and loam. Soybean grain yield varied significantly ($p<0.01$) between Mkanakhoti and Kaluluma EPA. Plant density also varied between farmers fields.

Key words: Grain yield, ISFM, MET, variability

Résumé

Une étude sur la ferme a été réalisée à Mkanakhoti et Kandeu, les Zones de Planification de la Vulgarisation (ZPV) dans le District de Kasungu, Malawi pour étudier l'effet des facteurs multi-environnementaux (économiques biophysiques et sociaux) sur le rendement du soja. La communauté a été sensibilisée après quoi, les agriculteurs devant héberger les essais ont été échantillonnés objectivement. Un total de 100 agriculteurs ont été sélectionnés. L'expérience a été aménagée en blocs aléatoires randomisés, avec chaque agriculteur considéré comme une répetition. Des parcelles expérimentales mesuraient 10 m par 10 m, ayant en moyenne 14 crêtes de terre. Des graines de soja ont été inoculées avec *Bradyrhizobium japonicum* en suivant une procédure décrite par le ministère de l'Agriculture, l'irrigation et la sécurité alimentaire. L'Ocepara 4 (variété de soja) a été plantée en rangées doubles à une distance de 0,25 x 0,005 m. Les ensembles de lignes doubles étaient séparées de 0,75 m. Le questionnaire a été utilisé pour recueillir des données socio-économiques, la gestion des parcelles et l'histoire des pratiques culturales. La texture du sol et le pH du sol ont été déterminés suivant les procédures standard. La majorité (64%) des agriculteurs ont atteint l'enseignement primaire. Les sols étaient essentiellement sablonneux et limoneux. Le rendement en grain de soja variait de manière significative (p <0,01) entre Mkanakhoti et Kaluluma ZPV. La densité des cultures variait également entre les champs des agriculteurs.

Mots clés: Le rendement en grains, GIFS, MET, la variabilité

Introduction

Soybean (*Glycine max*) is an important legume crop in cereal dominated cropping systems of Malawi due to its ability to improve soil fertility. Soybean fixes atmospheric nitrogen in symbiosis with Rhizobium through bacteria (Vanlauwe and Giller, 2006). Integration of legumes in cereal cropping system has been widely used in Integrated Soil Fertility Management (ISFM). Kamanga (1998) reported that crop rotation using soybean reduces N fertilizer needs and increases yield of subsequent maize. Rotation also reduces pest and disease incidences. Soybean is highly nutritious with 40-42% protein and 18-20% oil (Mhango, Snapp and Phiri, 2012). Soybean has wide uses. For example, it is processed into consumable and un-consumable products. Some of these products include oil, milk, margarine, soaps, inks, putty, insecticides, adhesives, linoleum, and lectin, backing flour, instant foods, livestock feeds, fish feed and fertilizer (Rolling, 2012).

Average soybean yields in Africa is 2.3 tonnes per hectare, far less than the global yield. Yields in Malawi are even less (1.3 t/ha) (Rolling, 2012). Though the potential yield of most varieties in Malawi is 4 tonnes per hectare, farmers average yield ranges from 0.4 to 1.0 tonnes per hectare (MoAFs, 2004). Factors responsible for this low variable yield of soybean in different areas of Malawi include rainfall amount, time of planting, soil type, soil pH and poor timing of weeds. These factors affect all stages of growth. Although many studies have been conducted on variability of soybean varieties, little has been studied on the effect of biophysical-social economic factors on the performance of soybean. Therefore, this study was carried out to evaluate the effect of biophysical and social economic factors on soybean yield in Malawi.

Methods

A trial was conducted in Kasungu district at Kandeu and Mkanakhoti Extension Planning Areas, 2014/2015 growing season. One hundred farmers were selected purposively after community sensitization in these two EPA's in order to select farmers for the study. The experiment was laid down in a randomized block design, with farmers as replicates. Farmers' plots were 10 m by 10 m, and on average contained 14 ridges. Ocepera 4 (Soybean variety) was inoculated with *Bradyrhizobium japonicum* following a procedure outlined by Ministry of Agriculture, Irrigation and Food Security (MoAFs, 2004). Soybean was planted on 2 rows per ridge at a spacing of 0.25 x 0.05 m. Ridges were 0.75 m apart. Data were collected through a survey and field measurements. A questionnaire was used to collect socio-economic data, crop management and cropping history. Soil texture was analyzed using the feel method while soil pH was determined in water (1:2.5 H_2O) (Wendt, 1996).

Results and discussions

Farmers and farmers' field characteristics. Of the farmers surveyed, 49% were male while 51% were female. Most of the households were male headed (85 %) and only 15% were female headed. Majority of the farmers had acquired primary education (64%). Soil analysis revealed that most of the fields (80%) surveyed had sandy and loam soils. Rainfall data showed that in Kaluluma rains tailed-off earlier than in Mkanakhoti.

Soybean yield in Kasungu district. Soybean yield varied across the EPA's. In Mkanakhoti yields almost doubled those in Kaluluma ($P < 0.001$) (Fig. 1). This could be related to more rainfall received in Mkanakhoti. Lack of moisture, especially during podding stage results to grain loss (Rolling, 2012).

Effect of plant density on yield of soybean. As expected, yield increased with increasing plant population. But it was interesting to note that farmers with plant populations of between below 300,000 and 500,000 got yields ranging from about 800 to above 3000 kg/ha. This yield was however not consistent with plant population. Although intra-plant competition due to close plant spacing is responsible for low yields at high populations ((Ronner *et al.*, 2015), this cannot explain the above yield pattern in relation to plant population. Lower plant density may result in increased leaf area, increase pods per branch and thus yield. This study however, shows that apart from the effects of plant population, other biophysical factors are at play with respect to grain yield.

Conclusion

The study showed that there was variation amongst farmer and fields between and within EPA's. This shows the influence of variation in the biophysical and social-economic factors among different farmers and fields. Therefore, good agronomic practices such as proper time of planting, weeding and optimum soil physical and chemical conditions should be emphasized for proper crop growth and yield maximisation.

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