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Short Communication: Response of insect foragers to four soybean mutant lines cultivated in savanna agro-ecology of Ghana

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Abstract. *Philip AA, Adu-Acheampong S, Addai IK. 2020. Short Communication: Response of insect foragers to four soybean mutant lines cultivated in savanna agroecology of Ghana. Asian J Agric 5: 1-3.* To increase soybean production, different lines have been developed with improved qualities to withstand problems associated with the production process. However, such development can render the lines (e.g., mutant lines) susceptible to pest attacks. We sampled for insect abundance and diversity within four soybean lines (150Gy, 200Gy, 250Gy, 300Gy) cultivated under two levels of NPK-15-15-15 fertilizer to check if mutagenesis has increased their attraction to insect activities including pest attacks. Some of the species recorded were *Acanthacris ruficornis*, *Apis mellifera*, *Spodoptera frugiperda*, *Helicoverpa armigera*, *Bemisia tabaci*, and *Callosobruchus* spp. The study also realized that NPK-15-15-15 had no significant impact on insects recorded within the various mutant lines. This only translates into no special pest attraction due to mutagenesis of not for any line. We recommend from this study that farmers should not have any reservation for cultivating any recommended mutant line for mass production after all other tests are completed on them before release.

Keywords: Fertilizer, foragers, insect, lines, mutagenesis, soybean

INTRODUCTION

To increase soybean production especially in northern Ghana, different lines and varieties have been developed (Santos 2019) (e.g., through metagenesis) with improved qualities to withstand problems associated with production such as pod shuttering, moisture stress, and disease susceptibility (Maganoba 2018). However, breeding against these traits can potentially predispose these lines to other unforeseen problems. For instance, several studies on mutagenesis of leguminous crops show that some properties of the crop can be altered after the change (Shekar 2017; Maganoba 2018; Singh and Sadhukhan 2019). Such changes may either be positive to bring more desirable qualities or negative and ranging from changing days to maturity, water retention or stress tolerance, pod shattering ability and even increasing susceptibility to pest attacks (Shekar 2017; Maganoba 2018; Singh and Sadhukhan 2019). As a result, developing improved varieties of the crop must factor in the susceptibility of the crop pest due to unforeseen losses it can impose on production. Although, these lines (150Gy, 200Gy, 250Gy, 300Gy) have been developed they are yet to be evaluated for their attraction or otherwise to insect foragers that may also include pests.

In accordance with that, we set out a field experiment to investigate the attractiveness or otherwise, of these four soybean lines developed through mutagenesis to insect foragers which also included pests as a measure of plant vigor. We hypothesized that mutagenesis has not rendered these lines more attractive to insect foragers that include pests. If so, we expect no significant differences in diversity and abundance of insect foragers between the different mutant lines. We specifically quantified the difference in abundance and diversity of insect foragers associated with the different mutant lines and determined the impact of fertilizers on the abundance of insect foragers (if any) within each of the mutant lines as a measure of their vigor under fertilization.

MATERIALS AND METHODS

Study site

The research was carried out at the University for Development Studies (UDS) Experimental Farm, Nyankpala, Ghana during the 2018 cropping season. Nyankpala is in the Tolon District, about 20 km southwest of Tamale in northern Ghana. It has a latitude of 9° 25'41"N and longitude of 0° 58' 42" W with an altitude 200 m above sea level (Serno and van der Weg 1985). Nyankpala is situated in the Guinea savanna agroecology with a tropical climate. Nyankpala experiences a unimodal pattern of rainfall with mean annual rainfall of 118.61 mm within 95 days with average annual temperature of 28.2°C (Nkrumah et al. 2014).

Field layout and experimental materials

The experimental field was demarcated into 60 plots of dimensions 4m x 3m with 3 replications in a Randomized Complete Block Design and a 1 meter spacing between blocks and plots. Four soybeans mutant lines (150Gy, 200Gy, 250Gy, 300Gy) were used for the experiment. The mutant lines were developed from a local variety 0 Gy which was used as a control. These mutant lines have been under evaluation since 2016 (Maganoba et al. 2018). We obtained these seeds from the Department of Agronomy, University for Development Studies, Nyamkpala-Tamale, Ghana.

Soybean cultivation and insect sampling

Planting was done at two (2) seeds per hole with a first manual weeding at two (2) weeks and the second at six (6) weeks after germination. Fertilizer was applied to plots marked for NPK-15-15-15 six (6) weeks after planting at a rate of 200 $kg.ha^{-1}$. Visual observation, handpicking and sweep net sampling were the main methods used for the study. Insect collections were transferred into the entomology laboratory of UDS and identified to the highest possible taxon. Sampling was done on four occasions at two-week intervals.

RESULTS AND DISCUSSION

Abundance of insect foragers

The study recorded a variety of species of insect foragers of soybean including pod, foliage, and flower feeders. Some of the recorded species were the fall armyworm, grasshoppers, bees, beetles, and bugs with both beneficial and pestiferous species. This record of occurrence of both beneficial insects and pestiferous ones (see table 1 below) agrees with a similar study by Hartman et al. (2016), which stated that there are both beneficial and harmful insect species associated with soybean.

Soybean lines and insect abundance

The study results further show that the control group (0Gy) recorded the highest insect abundance of 357 individuals followed by 300Gy (327) while 200Gy and 250Gy recorded 306 and 308 individuals respectively with 150Gy recording the least abundance of 301 individuals, but these differences were not statistically significant (P = 0.93). Also, there was no significant difference in species diversity between the different lines (P > 0.05).

The abundance and diversity of insect foragers recorded within these lines show that mutagenesis of the control line (0Gy) did not affect its attractiveness to insect foragers which also include pests as reported in other studies elsewhere (Narusaka et al. 2003; Scholz et al. 2014).

Impact of fertilizer on insect foragers abundance

Mutant lines that received 15-15-15 NPK fertilizer recorded the least number of insect foragers (762) individuals, while those that did not receive fertilizer recorded the highest abundance of 837. However, there was no statistically significant difference in both abundance and diversity between the lines with or without fertilizer (P = 0.23). This finding agrees with other studies that reported that fertilizers rarely affect arthropods directly although it influences the other characteristics of the plant such as, biochemistry morphology, and physiology which can indirectly affect the ecology of insects because of changes in dynamics of available food (Shikano 2017; War et al. 2018; Han et al. 2019).

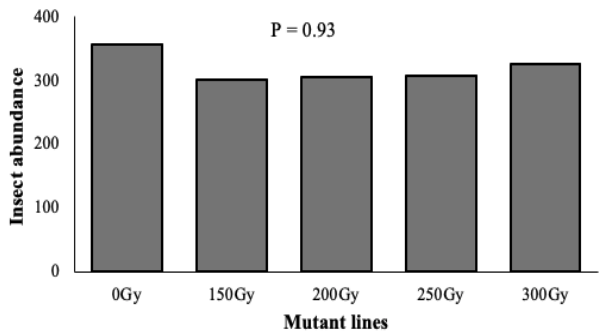

Figure 1. Response of soybean mutant lines to insect foragers abundance in Nyankpala, Ghana

Table 1: The list of some common insect foragers identified in soybean field at the UDS-Experimental Field at Nyankpala, Ghana

Common name	Scientific name	Family
Southern green stinkbug	*Nezara viridula*	Pentatomidae
Green semilooper	*Thysanoplusia orichalcea*	Noctuidae
Giant grasshopper	*Valanga* spp.	Acrididae
Black leaf beetle	*Plagiodera* spp.	Chrysomelidae
Spined soldier bug	*Podisus* spp.	Pentatomidae
Bruchid beetles	*Callosobruchus spp*	Chrysomelidae
Honeybee	*Apis mellifera*	Apidae
Flea beetle	*Disonycha* spp.	Cydnidae
Bean pod borer	*Maruca vitrata*	Erebidae
Cotton bollworm	*Helicoverpa armigera*	Chrysomelidae
The garden locust	*Acanthacris ruficornis*	Acrididae

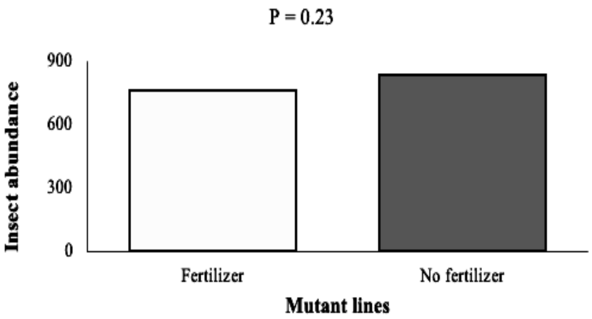

Figure 2. Impact of fertilizer on insect foragers abundance in Nyankpala, Ghana

We recommend that farmers should not have any reservations about using any recommended mutant line after screening for production because none of the lines have shown any special attraction to insect foragers which also includes pests.

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