Testing Roundup-ready Cotton in Uganda

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Abstract

Roundup-ready cotton was tested under confined field trials at NaSARRI-Serere in Eastern Uganda and Mubuku Prison Farm- Kasese, Western Uganda during the 2009/2010 and 2010/2011 cotton seasons. Weeds were controlled using two dosages of Roundup. These were the recommended rate and twice the recommended rate applied to transgenic cotton once or twice. The recommended rate was applied at 220 mls/15 litres of water, while the double rate was applied at 440 mls/15 litres. For the BPA 2002 control commercial variety, weed control was done through hand weeding three times. Major weeds of cotton were fully controlled by herbicide application at the two rates applied twice on the transgenic cotton without any negative effect to the cotton crop. At NaSARRI during the second season, application of the recommended rate of roundup twice to variety SG 125RRFlEX gave seed cotton yields of 1015.6 kg/ha, compared to 1265.6 kg/ha when the rate was doubled and applied twice. The local commercial variety BPA 2002 hand weeded three times during the same season yielded 1495.6 kg/ha. The results point to the prospective success of herbicide use on transgenic cotton under Ugandan conditions and strengthen the need for introgression of the technology to the local cotton varieties in the country.

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Introduction

Weeds are a big problem to cotton production in Uganda. Up to 98 % of cotton farmers in Uganda weed cotton by hand, 1.5 % use tractor and ox drawn weeders at one time, while 0.5 % use herbicides. Studies conducted at Serere revealed sharp increases in seed cotton yields, revenue, gross margins and costs with increased weeding frequency up to four times (Elobu et al, 1998). Beyond this frequency, the increases were low and gross margins fell.

The technology of transgenic herbicide tolerant (HT) plants has reduced the cost of weed control and boosted the production the production of several crops such as soya beans, maize, cotton, etc in several countries. For the case of cotton, Monsanto developed a technology in which a gene picked from a bacterium (*Agrobacterium tumefaciens)* and inserted in the plant genome. The gene leads the plant to produce enzymes that make it resistant to glyphosate. Glyphosate is the active ingredient in Roundup which is responsible for killing all plants to which the herbicide is sprayed.

The objective of this work was therefore to assess the ability of Monsanto's genetically modified (GM) cotton varieties to tolerate applications of Roundup herbicide, as a weed control method

under Uganda's conditions. The gene was later to be introgressed into Uganda's cotton varieties for commercial production after three years of confined field trials, if results were promising.

Materials and methods

Cotton was grown under confined field trials at the National Semi Arid Resources Research Institute (NaSARRI) in Serere district and at Mubuku Government Prison Farm in Kasese district in 2009/2010 and 2010/2011 cotton seasons. Fourteen (14) treatments were studied in the first season. They comprised of five cotton varieties, two hand weeding and three herbicide application schedules. The five varieties were SG125RRF and DP110 which were transgenic and had the gene for resistance to roundup, their isolines (SG 125 and 99M03, respectively) and the non-transgenic Ugandan commercial variety (BPA 2002). The two hand weeding treatments were weeding six times to give 100 % weed-free situation throughout the season and Ugandan Farmers' practice of weeding three times. The three herbicide application schedules were 220 mls of Roundup/15 litres of water applied once over the top of cotton, 220 mls/15 litres applied twice over the top of cotton, and 440 mls/15 litres applied twice over the top of cotton.

In the second season twelve treatments were studied and they were composed of: (a) four varieties *(*SG 125RRF with single gene for tolerance to Roundup herbicide, SG 125 B2RF with stack genes for Roundup tolerance and bollworm resistance, their isoline SG 125 and the local commercial BPA 2002 as the local control. (b) Two hand weeding methods as in season one (c) Three herbicide application schedules as described for the first season. Weed data was recorded before and after any herbicide application from two stations of 0.5 m^2 per plot. Sucking pests, especially aphids, white flies, lygus, etc, were controlled from all plots using Golan at a rate of 24 mls /15 litres of water while bollworms were controlled by sprays with Twiga Cyper at a rate of 120 mls /15 litres of water. At the end of each trial and after taking all the required data, all the cotton from the confined field trial sites was incinerated in the incineration pit within the facility. At harvest, cotton for yield data was picked from four middle rows leaving three stands on either ends of each row.

Results and discussions

There were big reductions in numbers of weed species counted a week after Roundup application, compared to numbers before. This was true for both broad-leafed weeds and grasses. The cocommon ones at Mubuku were *Caccia occidentalis, Caccia obtusifolia, Portulaca quadrifida, Portulaca oleraceae, Solanum incanum, Commelina benghalensis, Allium spp* and *Cyperus rotundus.* At NaSARRI *Spermacoce latifolia, Commelina benghalensis, Cyperus rotundus, Eleocharis companata, Paspalum* Spp., *Panicum maximum* and *Digitaria scalarum* were the common weeds observed after spraying Roundup. At NaSARRI, the biggest reduction was caused by application of 440 mls/15 litres (Table 1). Before Roundup application, numbers of both broad leafed weeds and grasses were not significantly different across treatments, as expected. Significant reductions occurred after herbicide application. At Mubuku, 220 mls/15 litres, especially on variety SG 125 RRFLEX, worked effectively like 440 mls/15 litres. The weeds observed after Roundup application, however, were weak, heading to die and could not offer any significant competition to the cotton crop.

Yields of the transgenic cotton varieties and their isolines at NaSARRI were not significantly different from BPA 2002 under all the weed management treatments. Weeds as a variable had no major impact on yields at NaSARRI suggesting that below a certain threshold of weeds, cotton performance was not affected. All the weed management treatments controlled weeds below that threshold. At Mubuku, however, all the "new" technologies out-yielded BPA 2002 under Farmers' practice. SG125RRF and its isoline SG125 performed better than DP110 and its isoline 99M03, which in turn performed better than the control, BPA 2002.

At NaSARRI during the second season, the stack gene variety (SG125B2RF) hand weeded six times significantly out yielded BPA 2002. When sprayed with Roundup once or twice, yields were not significantly different from the controls. The same observation was true for the other transgenic variety and both isolines. They exhibited no superiority over BPA 2002. At Mubuku, application of the recommended rate of Roundup twice, and double the recommended rate applied twice significantly increased yields of the transgenic varieties SG125RRFEX and SG125B2RF compared to the control BPA 2002 weeded three times an even six times.

These results point to the prospective success of herbicide use on transgenic cotton under Ugandan conditions and strengthen the need for introgression of the technology to the local cotton varieties in the country.

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