Evaluating Permanent Planting Basins to Optimize Plant Populations of Maize and Beans

Permanent planting basins (PPBs), as used in conservation farming, is a minimum tillage method. It is easily practiced by small-scale farmers. “You do not need special equipment to start conservation farming; all you need is a hoe and a piece of string” (IIRR and ACTN, 2005). It enhances the capture and storage of rainwater and allows precise nutrient application of limited nutrient resources. The method is widely used in southern Africa (Zambia and Zimbabwe) to reduce the risk of crop failure due to erratic rainfall. PPB, in combination with improved seed and crop residues, creates a mulch cover that reduces evaporation losses and has consistently increased average yields (Twomlow *et al.,* 2006).

This technology contributes to efficient and effective use of available water resources, which is important in promoting water-smart agriculture. This crop management method was introduced to Uganda from southern Africa and there was a need to understand how the technology responds to the different agroecological zones. This was intended to build practical evidence on how farmers in Uganda could apply the technology for optimum yield. The National Agricultural Research Organization, with financial support from Sustainable Intensification of Maize-Legume Cropping System for Food Security in Eastern and Southern Africa (SIMLESA) and Cooperative League of the United States of America (CLUSA), undertook a study aimed at establishing the optimum plant populations for both maize and beans in the agroecological (AEZ) zones of Lake Victoria crescent and northeastern savannah grassland.

Methodology

The studies were done at the National Agricultural Research Laboratories (NARL)–Kawanda in the Lake Victoria crescent AEZ and the Ngetta Zonal Agricultural Research and Development Institute (NgeZARDI) (see map). Kawanda receives an average annual rainfall of 1,200 mm while Lira gets 1,305.3 mm. The experimental design was a randomized complete block with three replications for Longe5 maize variety and NABE 15 bean variety. The treatments were three, four, and five plants per PPB for maize and six, eight, and 10 plants per PPB for beans.

The three and six plants/basin for maize and beans, respectively, were the control treatments.

Before field preparations, baseline soil analysis was done to establish the soil status fertility and fertilizer requirement. Fields were slashed; weeds were allowed to sprout and they were sprayed with glyphosate at a rate of 7.5 l/ha. Basins 35 cm long × 15 cm wide × 15 cm deep, with a spacing of 90 cm between rows and 75 cm within rows from center to center of the PPB were marked out using strings and dug before the onset of rains. Available crop residues were used as mulch. Organic manure at a rate of 1 mug PPB was applied. In addition, fertilizer diamonium phosphate (DAP), measured in a leveled soda bottle cap, was applied at the rate of two caps per pit. The pits were covered with topsoil before the seeds were planted. When the maize were knee-high, a mineral water bottle-top of nitrogen was applied per basin. The trials were done in two cropping seasons in 2013. Data were collected from 24 plots and analyzed using ANOVA to determine optimum yield based on the plant population per PPB. The outcomes of the study were disseminated and experiments are being tried by eight farmer groups in Nakasongola and Lira districts.

Map of Uganda showing location of study sites

Results

- There was a 27% increase in grain yield by using four plants per basin compared with three plants per basin currently practiced for the Lake Victoria crescent AEZ at NARL in season 2013A.
- For the northeastern savannah AEZ at NgeZARDI, there was no significant difference in grain yield between three, four, and five plants per basin for both seasons (2013A and 2013B).
- Notwithstanding the differences in plant population per basin, bean grain yield at both NARL-Kawanda and NgeZARDI was much lower than the potential yield of 2.5 tons/ha. Also, there was no significant difference between six, eight, and 10 plants per basin for both agroecologies.

Recommendations

- The maize plant population of maize the plant population of 59,259 plants/ha (four plants per PPB) was the optimum number in areas with relatively high soil moisture such as the Lake Victoria crescent AEZ.
- A plant population of 44,444 plants/ha (three plants per PPB) was the optimum number for the northeastern savannah grassland where there is low soil moisture.
- There was no significant difference in the bean plant population per basin. In light of this result, it was recommended that spacing of PPB be reduced from 90 x 75 cm to 60 x 60 cm to increase the optimum plant population, making it closer to the conventional practice of sowing 200,000 plants/ha. The implication is that, in each basin, a farmer can plant six seeds.

In line with the principle of crop rotation in conservation agriculture, the study further recommended the optimum plant population for maize as follows: three plants per basin at 60 x 60

cm of basin spacing or 83,333 plants/ha for Lake Victoria crescent AEZ and two plants per basin at 60 x 60 cm of basin spacing or 55,555 plants/ha for the northeastern savannah grassland agroecology.

Authors

Drake N. Mubiru
National Agricultural Research Laboratories

Godfrey Otim
Agronomist
Ngeta Zonal Agriculture Research and Development Institute
Email: otimgw@gmail.com

Jalia Namakula
National Agricultural Research Laboratories

James Lwasa
National Agricultural Research Laboratories

John Elem
Cooperative League of the United States of America

William Nanyeenya
National Livestock Resources Research Institute

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