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Importance of Pesticides for Growing Maize in Sub-Saharan Africa

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INTRODUCTION

Maize, the most important food staple in Sub-Saharan Africa (SSA), is critical to food security. It currently covers 25 million hectares in SSA, largely on smallholder farms. Maize accounts for about 20% of the calorie intake of 50% of the population in SSA. Yet, SSA is the region with the lowest maize yields in the world: 1.5t/ha against a global average of 4.9t/ha. Among the biotic constraints in maize production are infestations of weeds, insects and disease pathogens that could be controlled with increased use of insecticides, herbicides and fungicides.

INSECTICIDES

Stemborers are major pests of maize in all African countries south of the Sahara. Damage caused by stemborers is one of the main causes of low maize yields.[1] Female stemborer moths lay eggs on maize leaves. The newly emerged larvae enter into the whorls of young maize plants and feed actively on the tender leaves. In older plants the larvae bore into the stem and start tunneling. Plants thus affected have stunted and poor growth, reduced yield, and are more susceptible to wind lodging and secondary infections.[2] Infestation levels of 100% of plants are frequently observed.[4] In Mozambique, yield losses due to stemborer attack are often more than 50% in farmers' fields.[4] In Zimbabwe yield losses of 43% occur at the smallholder level.[7] In Ethiopia, stemborers collectively result in maize yield losses of 20-50% with occurrences of total crop failure.[8]

Control options for managing stemborers include chemical, biological, cultural, and host plant resistance. Chemical control methods are most effective and are recommended by national agricultural extension agencies.[5] Several insecticides, formulated either as granules or spray applications, are registered for

Stemborer in stalk

stemborer control in African countries.[7] Because of their effectiveness and relative ease of application, the use of granular formulations is recommended for small scale farmers. Recent research in Kenya in 135 farm fields compared typical farmer practice with the application of a granular insecticide into the maize whorl.[9] The resulting estimate of the 4-year Study was that an average national crop loss of 13.5% was occurring due to uncontrolled stemborers.[9] However, only about 5% of smallholder farmers in Kenya report using insecticides for stemborer.[6] In Ethiopia and Mozambique, large-scale commercial farmers rely on insecticides to control stemborers; communal and small scale commercial growers use insecticides only rarely.[7,4]

Lack of effective Extension services and training for farmers hinders more widespread adoption of chemical insecticides for stemborer control. Renewed research efforts on chemical control, with smallholders as the target group, are clearly necessary.[7] In South Africa, stemborer problems have been reduced because of the widespread use of chemical insecticides and the planting of biotech maize varieties that contain *Bt* toxins that are effective against stemborers. The biotech maize varieties have not been approved for planting elsewhere in Africa.

FUNGICIDES

Grey leaf spot is considered one of the principal constraints to maize production in sub-Saharan Africa. In Africa, grey leaf spot was first observed causing economic losses in maize fields in South Africa during the 1990/91 growing season. Since then, the pathogen has been reported as being widespread in Ethiopia, Kenya, Malawi, Mozambique and Zimbabwe and to a lesser extent in the Congo, Nigeria, Tanzania and Zambia. Grey leaf spot of maize is caused by the fungus *Cercospora zeae-maydis* which is known to infect only maize. Following periods of high humidity, the fungus produces spores in infested debris in the spring. Losses associated with grey leaf spot occur when photosynthetic tissue is rendered nonfunctional due to lesions and/or the blighting of entire leaves.[11]

Maize (Left=Fungicide Treated; Right=Untreated)

In Malawi, maize yield losses of 29-69% due to grey leaf spot have been reported.[12] A survey conducted in western Ethiopia indicated yield losses due to the disease ranging from 22 to 75%.[13] Grey leaf spot was first reported in Kenya and Zimbabwe during the 1995 growing season, when small scale maize farmers experienced significant yield losses. Small-scale farmers have continued to experience considerable yield losses estimated at 35% in Zimbabwe and 45% in Kenya.[14] In Tanzania the disease causes grain losses ranging from 15 to 40%.[15] In South Africa, grain yield losses due to grey leaf spot are usually between 30 to 40%.[16]

Fungicides have been found to provide excellent control of grey leaf spot. Few hybrids have sufficient resistance to prevent yield losses due to grey leaf spot. Research in South Africa has demonstrated that even the most resistant hybrids respond to fungicide treatment. In tests in Zambia, grain yield differences in sprayed and unsprayed treatments ranged from 27 to 54%.[17]

HERBICIDES

Hand-weeding is the predominant weed control practice on smallholder maize farms in Africa. Weeds compete with maize crops for nutrients, space, light, and water thus reducing maize yield. African studies have documented that season-long weed competition causes maize yield losses of 50 to 90%.[20] Average yields obtained by smallholder farms are considerably less than yields demonstrated in African research plots utilizing best management practices. The failure of farmers to replicate the weed control practices of the research farms is a major cause for low maize yields. At the experimental farms, maximum yields are achieved if

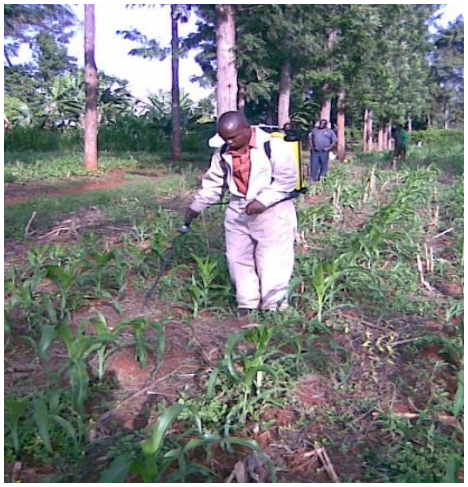
Weedy Maize Field

maize fields are kept weed-free for the first 56 days after planting.[21] One week's delay in first weeding may reduce maize yields by one-third.[22] On most farms, weeding maize usually competes with other farm activities and is postponed to a later date. In Malawi,

one-third of the area planted to maize by smallholders is either left un-weeded or weeded after the critical first six weeks.[22] Shortages of labor early in the season results in delayed weeding and subsequent maize yield losses of 15 to 90% due to weed competition.[19] In Nigeria, maize farmers' weeding practice (one weeding) resulted in 42% yield loss in comparison to fields weeded three times.[18]

Experiments with herbicides to control weeds in maize crops have been conducted in sub-Saharan Africa since the 1960s. Although herbicides have been extensively studied in Africa, there has been no mechanism to disseminate the technology to smallholders once the research process was over.

In Zimbabwe, research with herbicides resulted in yield increases of up to 50% in maize.[10] Use of herbicides in Kenyan weed trials resulted in 33% higher maize yields than farmer practice of hand-weeding.[3] The adoption of herbicides in African maize fields is likely to lead to increased production due to not only improved weed control but also by facilitating the adoption of fertilizer use. The benefits of fertilizer depend on weed control. The application of fertilizers causes more weeds to grow which, in turn, increases the need for more hand-weeding.



Herbicide application

CONCLUSIONS

Chemical control of insects, pathogens and weeds has been shown to be the most effective technology for preventing losses in maize crops and increasing maize yields in SSA. Many different insecticides, fungicides and herbicides have been recommended for control of maize pests. However, pesticide use is limited among smallholder farmers in the SSA. Improving accessibility to pesticides and training smallholders in their effective use would enable wide adoption and lead to significant increases in maize production in SSA.

Box 1: Herbicide Success in Ghana

"Herbicides is widely used among maize farmers in Ghana. 73% of maize area was applied with herbicide. Given serious labor constraints and the relatively cheaper herbicide formulations, herbicide use has been popular across all regions….. It is cheaper to purchase herbicide than to hire labor or use family labor… Plots with herbicide have a higher yield than those without herbicide... Therefore, economic incentives dictate the use of herbicides among maize farmers in Ghana."[23]

Box 2: IITA Recommends Herbicides

"Although manual weeding is an age-old practice in West Africa, it is no longer sustainable because of high labor costs and aging farm population. Judicious use of herbicides is recommended to control weeds and increase maize productivity. We normally recommend the use of postemergence herbicides to kill weeds before land preparation and planting."[25]

Box 3: Herbicide Benefits in Zambia

"Although only 3% of fields had herbicides applied, results suggest the benefits of its use are quite high…….herbicide use would increase gross margins by roughly a third…. Public policy measure should be considered to educate farmers about the benefits of herbicide application, as its contribution to smallholder income growth… may be comparable to and highly synergistic with increased fertilizer use."[24]

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