

Importance of Pesticides for Growing Wheat in South Asia

Leonard P. Gianessi

INTRODUCTION

The four South Asian countries of Pakistan, India, Nepal and Bangladesh grow about 121 million tons of wheat on 40 million hectares. Wheat provides about 20-24% of the protein and the calories consumed by the 1.6 billion people living in the four countries. India is the second and Pakistan is the eighth largest wheat-producing country in the world (China is first).

Because of increasing population, wheat production in the four countries needs to increase by 2-2.5% per year by 2050.⁴ Because there is little available land to expand the area planted to wheat, wheat production increase will have to be the result of increased yield.⁴ Increases in wheat yields have slowed in South Asia in recent years to about .3 %.⁸ The stagnation in wheat yield increase may lead to shortfalls in production necessitating the importation of large quantities of wheat creating serious concerns for food security and diminishing foreign currency reserves.

There is a big yield gap (around 2.0 tons/hectare) between research stations and farmers' wheat fields in South Asia.⁴ Closing the yield gap by overcoming current production constraints can lead to large increases in wheat production in the region. Uncontrolled weeds and diseases have been identified as major factors in current low wheat yields in South Asia.

HERBICIDES

Weeds reduce the yield of wheat by competing with the crop for water, light, nutrients and space. Uncontrolled weeds can reduce wheat production in South Asia by 50-80%.²⁴ Weed infestation is the main cause of low wheat yields in Pakistan and India and typically reduces wheat production by 25-35%.^{19,3} A survey in Peshawar region in Pakistan found that there were 31 major weeds in wheat fields.²⁶ 91% of wheat farmers in Peshawar reported yield reduction in wheat due to weeds of 20-50%.²⁶ Competition from uncontrolled weeds has been reported as a severe constraint on wheat production throughout South Asia.⁷

Hand weeding is the traditional method for weed control in wheat in South Asia. However, most farmers do an inadequate job of hand weeding. It takes one working day for twenty laborers to hand weed one hectare of wheat.²² Shortages of labor and increased wages discourage proper hand weeding with effectiveness being reduced when rains interrupt the work.

In India herbicides are used on 10% of the wheat area to control grassy weeds and on 20-25% of the area to control broadleaf weeds.⁶ In the rice-wheat system of Punjab, Harayana, western Uttar Pradesh and Uttarakhand, 57% of the wheat area is treated with herbicides.²⁸ About 50% of Pakistan's wheat acreage is treated with herbicides.² In Bangladesh herbicides are



Herbicide Treated Wheat in India (Untreated vs. Treated)

typically not used with one hand weeding being the recommended practice although farmers are reluctant to weed the field even one time.⁵ 5-10% of wheat farmers in Nepal apply herbicides.¹ Weed problems in Nepal have become so great that wheat fields are often harvested before maturity and together with the weeds, is fed to livestock.²⁹

Research in Pakistan has shown that herbicides reduced weed biomass by 95% (from 253 to 14 weeds/m²) with an increase in wheat yield of 64%.²³ Recent experiments in India showed that combinations of herbicides increased wheat yields by 1.7 and 2.1 times over the weedy check.^{30,31} Research in Pakistan in farmers' fields demonstrated that on farms where herbicides were used, wheat yields were 13-29% higher than in farm fields where herbicides were not used.²⁵ As a result of herbicide demonstrations in a village in Pakistan, 76% of the farmers adopted herbicides within three years.²⁷ Farmers who applied herbicides had an average wheat yield of 3.9 t/ha, compared to 2.7 t/ha for those not using herbicides.²⁷ Recent increases in wheat yields in Pakistan have been attributed to increased use of herbicides.²⁰

A survey in India of wheat farmers who do not use herbicides revealed that lack of knowledge was the main reason for non-adoption (41%).²¹ Other significant factors were lack of skill (13%) and lack of guidance (24%). About 65% of the farmers suggested that extension systems should publicize the method of chemical use and highlight its instruction.²¹

FUNGICIDES

Yellow rust (also called stripe rust) and brown rust (also called leaf rust) are the major diseases of wheat which affect almost all of India.⁴ Rust spores that land on wheat plants germinate and infect the plant. Tiny tubes penetrate host cells to withdraw nutrients. Fungus tissue proliferates beneath the epidermis until the epidermis bursts and pustules erupt. Each pustule contains thousands of spores that can be carried by the



Workshop participant gaining Herbicide training

wind to infect other plants. Grain yield is reduced by interference with grain filling, which results in a reduction in the number and size of kernels. .

Resistance to rust was successfully incorporated into wheat in the 1950s. However, host resistance genes are often overcome by the pathogen. In 1971-72 and the following season stripe rust appeared in epidemic form in Punjab, Haryana, and Western Utter Pradesh and nearly .8-1.5 million tons of wheat were lost. In 1978-79, large areas in Narmada Valley were hit by stem rust and losses of 60-75% of the normal grain yield occurred.

The frequent failure of resistant wheat varieties has led to interest in fungicides. In India, breakdown in wheat resistance to yellow rust occurred in 2008-2009 and heavy losses due to rust epidemics were reported. To avoid losses in 2009-2010, intensive monitoring of the rust populations were carried out. The disease was managed by the timely application of fungicides and the disease did not become widespread in 2009-2010.¹⁵ Maximum loss in grain yield was found to be 63% where no spray of fungicide was made.¹⁵ Wherever the disease was noticed, the farmers were advised to spray their fields.¹⁵ Research in India has shown that fungicides for leaf rust and yellow rust provide disease control of 98.5% and 95.1% respectively with corresponding 65.7% and 52.0% increase in yield.¹¹

In India, powdery mildew is widespread in the Punjab with losses of grain yield of 20% in highly infected crop.¹³ Since none of the recommended varieties is resistant to the disease, the use of fungicides has been recommended.¹⁴ Research in India has shown an 18% increase in wheat yield following two fungicide sprays for control of powdery mildew.¹³ Powdery mildew on wheat is very well managed by spraying fungicides.⁹

Diseases of wheat (yellow rust, leaf rust and powdery mildew) are estimated to affect 1.2 million hectares in Pakistan with typical yield losses of 5-30%.³ In a 1995 yellow rust epidemic in Pakistan wheat losses of 20% occurred in affected areas.¹² In Nepal, 20 to 30% of the total wheat area is affected annually by yellow rust with typical yield loss of 10 to 15%.¹

Foliar blight of wheat in South Asia occurs as a disease complex of spot blotch and tan spot. Foliar blight is commonly referred to as *Helminthosporium* leaf blight. Foliar blight is the main biotic stress of wheat in the rice-wheat systems on the Gangetic plains of India, Nepal and Bangladesh where it causes, up to 15% yield loss as observed in farmers' fields in Nepal.¹⁶

The combined effect of high temperature, high humidity and long leaf wetness period caused primarily by daily dew provides a conducive environment for spot blotch development in the Gangetic Plain.¹⁷ There is an increasing trend in the number of cloudy and foggy days



Wheat Stripe Rust

during winter in South Asia which increases leaf wetness by several hours and favors the development of the foliar blight pathogen.¹⁷

In India, management of spot blotch is highly dependent on chemical fungicides as adequate levels of host-plant resistance are scarce.¹⁸ In experiments in India foliar applications of fungicides reduced the disease by 80% and increased yield by 20%.¹⁸ In Nepal yield losses to foliar blights were as high as 34% when fungicides were not used.¹⁶

CONCLUSIONS

Given the extent of yield losses in wheat due to weeds and diseases, there is a need to popularize the use of herbicides and fungicides through on-farm demonstration and extension programs in South Asia. Demonstrating their use and providing guidance on appropriate spraying times and application rates can assist considerably in the adoption of these improved technologies.²⁷

Box 1: CIMMYT on Importance of Herbicides for Cereal Crops in Asia

"Herbicides will continue to be the preferred alternative in the foreseeable future. In intensive cereal crop production systems, the use of herbicides is cost-effective relative to the use of human labor, because the seasonality of weeding often creates labor scarcity, and wage rates for weeding surpass those for other crop management operations. The use of herbicides also gained impetus from the general rise in farm wages resulting from overall economic growth and growth in nonfarm employment opportunities, particularly in Asia. As cheap herbicides became available and farm wages rose, cereal crop farmers increasingly substituted herbicides for human labor. The savings in labor cost have more than compensated for the additional cost of herbicides. There are few genetic and management alternatives to herbicides, and those that exist are generally not very cost effective. "^{10,}

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