

## Importance of Pesticides for Growing Maize in South and Southeast Asia

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#### INTRODUCTION

Traditionally, maize was grown in South and Southeast Asia primarily as a subsistence food crop. In recent years, the consumption of maize as a food crop has declined while the use of maize as a feed crop has increased. The increased production of maize has largely been driven by the increased demand for maize as feed for the rapidly expanding poultry industry. The “maize-livestock revolution” has arisen from a combination of population increase, changes in the diets of millions of people towards milk, eggs, and meat, increasing urbanization and growth in disposable incomes.<sup>29</sup>

The major maize producing countries in Southeast Asia are Indonesia, Philippines, Vietnam, and Thailand and in South Asia the major producers are India, Pakistan and Nepal. Maize area totals 20 million hectares in these seven countries. Maize production in South and Southeast Asia has more than tripled since 1982 reaching 65 million tons in 2012. However, this production has not met the national demand and maize imports into the seven countries total 4.5 million tons.



Brown Stripe Downy Mildew

The rate of demand for maize is outpacing the rate of increased maize production and production will need to increase to avoid major increases in imports.

Significant growth opportunities remain for maize through increasing yield by controlling insects, diseases and weeds. The potential for maize yield in South and Southeast Asia has been estimated at 10 T/ha; however, current yields average 2.3-3.2 T/ha.<sup>21</sup> 20% of the yield gap in South and Southeast Asian maize yields is due to uncontrolled weeds, insects and diseases.<sup>21</sup>

Insects and diseases are a serious constraint on half of the maize hectares in Asia.<sup>28</sup> The average yield gain by removing insect and disease constraints is estimated at 14%.<sup>28</sup> Weeds are a substantial problem in maize fields in Asia and yield losses as high as 100% occur.

#### FUNGICIDES

The downy mildew diseases have been a major limiting factor in production of maize in Asia since the early 1900s. Java downy mildew is of great importance in Indonesia, where depending on the year, 20-80% of the total maize harvests are lost.<sup>1</sup> Philippine downy mildew is widespread in Nepal, northern Vietnam, northern India and in the Philippines, where the damage usually affects 40-60% of the total maize yield.<sup>1,4</sup> Brown stripe downy mildew incidence is greatest in regions of high rainfall in India and has been reported from most maize-growing regions of that country with yield losses ranging from 20-90%.<sup>2</sup> In Nepal, downy mildew epidemics have caused maize losses as high as 50%.<sup>4</sup> In India and the Philippines, downy mildew is estimated to lower national maize production by 13% and 8% respectively.<sup>4,14</sup>

Downy mildew infections occur both as a result of soil borne overwintering spores which infect young plants

and from spores produced by nearby infected hosts. Once inside maize plants, the fungus moves systemically throughout the plant. Infected leaves show discolored streaks and have a mildew growth. Most early infected plants usually die within a month. When cobs are formed, they are small and poorly-filled.

Research has demonstrated that systemic fungicides applied as seed treatments and/or foliar sprays provide excellent control of downy mildew.<sup>3</sup> Yield increases of 8-10% are possible through seed treatment alone.<sup>4</sup> Seed treatments protect young seedlings from soil-borne spores as the fungicide is taken up systemically in the developing seedling.<sup>6</sup> Research has shown that seed treatment combined with one foliar spray to control brown stripe downy mildew increased maize yield by 34%.<sup>5</sup>

Fungicides are widely-used on maize crops in Thailand and Vietnam, but are used on less than 5% of the maize hectares in India, Indonesia and the Philippines.<sup>7,8</sup> Farmers lack of knowledge of how to prevent diseases with fungicides has resulted in continuing losses in maize yields in Asia.<sup>23</sup> Most farmers in the affected areas do not treat seeds with fungicides while in areas where fungicide seed treatments are applied, downy mildew is negligible.<sup>23</sup> Recently, as a result of higher maize prices in India, seed treatments to control downy mildew are being recommended to farmers.<sup>9</sup>



Weedy Maize Field

## HERBICIDES

In Asia, maize is largely a rainy season crop. Because of warm and moist weather, a variety of grass and broadleaf weeds invade maize fields frequently even before the crop germinates. Weeds compete with maize plants for space, moisture, nutrients and light and, if left uncontrolled, can reduce maize yields by 29-74%.<sup>10</sup> Traditionally, manual hand weeding has been the predominant method of weed control used by maize farmers in Asia.<sup>17</sup> If performed with enough frequency and at the right times, hand weeding results in maize yields that are equivalent to yields with herbicides.<sup>11</sup> However, due to shortage of labor and frequent monsoon rains and high temperatures during the early growth period of maize, hand weeding is often delayed or neglected altogether.<sup>11</sup> As a result, severe uncontrolled weed infestations have been identified as one of the major reasons causing low maize yields in Asia.<sup>10</sup> In the Philippines, actual losses due to weeds in maize fields have been reported at 15-30%.<sup>12</sup> In India, 39 trials compared maize yields with herbicides to yields obtained with farmers weed control methods; the maize yields with herbicides were 19% higher.<sup>13</sup>

In Pakistan, research demonstrated a 75% increase in maize yield with herbicides in comparison to the unweeded check. Herbicide use on maize is low in India, Pakistan and the Philippines as farmers manually weed fields.<sup>17,7,16</sup> In a weed control experiment in Pakistan, 40 person days of labor per hectare of weeding was required to produce maize yields equivalent to herbicide treatments.<sup>17</sup> In Pakistan, national maize yield loss due to weeds has been estimated at 14%.<sup>18</sup> Maize farmers in Thailand, Vietnam, and Indonesia use herbicides extensively.<sup>7</sup> In Thailand, most farmers apply pre emergence and post emergence herbicides to maize fields.<sup>19</sup> In the Philippines, herbicides are very seldom used in maize fields.<sup>8</sup> In India, weeds are ranked as the worst production constraint by maize farmers.<sup>20</sup> A recent survey in India showed that for farms using herbicides in maize, labor usage was about 33 hours lower and yield was higher by about 4 quintals.<sup>30</sup>



Hand Weeding Maize

## INSECTICIDES

The stem borer complex is a major cause of low maize yields in Asia. The Asian corn borer is a serious pest of maize in Vietnam, Indonesia, Thailand, and the Philippines.<sup>25</sup> One of the major reasons for the low productivity of maize in India and Pakistan is damage by insects, notably spotted stem borers.<sup>24</sup> Stem borers damage the vascular tissue of the plant and provide a portal of entry for stalk and ear rots. The destruction is caused by the larvae which after hatching, feed on leaves, and then bore their way downward into the stem. Severe infestations of maize borers can result in 75-90% crop loss.<sup>18,25</sup>



Stem Borer Damage

Insecticides are not widely used in maize in India and Pakistan.<sup>7,20</sup> In India stem borers are estimated to cause maize yield loss of 7.5% on 80-100% of the maize acres.<sup>20</sup> In Pakistan, national maize yield loss due to insects totals 18%.<sup>18</sup> Insecticides are used extensively in maize in Indonesia and Thailand.<sup>7,26</sup>

Most Philippine maize farmers mention the Asian corn borer as an annual problem.<sup>8</sup> Average historical (1988-2005) yield losses in maize due to corn borer in the Philippines averaged 16%.<sup>27</sup> Maize yield loss in Vietnam due to borers totals about 4% annually.<sup>22</sup> Insecticides are effective when used at the period of borer egg hatching and the first three instars, before the larvae enter the stem.<sup>24</sup> Insecticidal seed treatment followed by granular applications in the whorl increased maize yield by 80-100% in experiments in Pakistan.<sup>18,15</sup> Experiments in the Philippines demonstrated that granular insecticide applications in the whorls increased maize yield by 61-100%.<sup>25</sup>

## CONCLUSIONS

Soil and climate conditions in South and Southeast Asia are ideal for maize production. However, maize yields are very low. Uncontrolled weeds, insects and diseases are a major cause of low yields. The growing demand for maize in Asia will have to be met by increased domestic production from adoption of new technologies. Efforts to reduce maize losses through the adoption of pesticides offer tremendous opportunities for increasing and stabilizing maize productivity in Asia. Losses can be minimized by following recommended methods for applying insecticides, fungicides, and herbicides.

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