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Novel options for the control of fruit and vegetable diseases

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Introduction

Improvements in living standards around the world are associated with an ever-increasing demand for a year-round and diverse supply of high-quality fresh fruit and vegetables. This trend has had a tremendous impact on fruit and vegetable production in many countries in Asia, including Korea. The increased domestic demand for fruits and vegetables has been paralleled by a significant rise in exports to other countries. The challenge for Asian farmers has been the need to produce crops that meet the stringent quality demands of export markets.

Disease Control Options in Fruit and Vegetable Crops

Plant pathologists are aware of the perils of intensive production systems. Cultivation of the same crop over a large area increases the risk of disease epidemics. Unfortunately, many of the crop varieties favoured by consumers are those that succumb easily to plant pathogens. Therefore, careful management of plant disease is mandatory in almost all commercial production of fruits and vegetables.

The main avenues for achieving disease control are as follows:

- Selection of a tolerant or resistant crop variety
- Identification of cultural practices that will reduce the severity of disease infection
- Use of biocontrol agents
- Use of products that stimulate host defence responses
- Use of chemical fungicides or bactericides
- Vector control, in the case of diseases caused by viruses or mollicutes

Cultural practices such as selection of planting material, irrigation method, fertilization and nutrient regime, plant spacing, pruning, weed control and crop rotation can exert a profound effect upon the development of disease. When disease-susceptible cultivars are used, it is essential to identify the conditions that minimise disease development.

Biocontrol agents (BCAs) have had limited commercial exploitation in Asian fruit and vegetable production, mainly due to their high specificity, and also because they are generally unable to offer robust disease control under conditions of high disease pressure. However some promising BCAs based on antagonistic micro-organisms, such as *Streptomyces griseoviridis, Trichoderma* spp & *Coniothyrium minitans*, have shown useful effects in certain European glasshouse crops.

A novel approach to the treatment of plant disease has been the introduction of development of chemicals that act indirectly by stimulating the host plant's natural defences (known as Systemic Acquired Resistance, SAR). The most widely-used SAR product is acibenzolar-S-methyl (Boost®, Bion®, Actigard®). Acibenzolar-S-methyl is used at extremely low rates, and acts as an analogue of salicylic acid, activating the plant's defence genes. In Korea, programmes based on Bion® have given very satisfactory control of vegetable diseases.

Novel Fungicides for Fruit and Vegetable Crops

The remainder of this paper will focus on novel fungicide solutions for the control of fruit and vegetable diseases. In the last decade, a number of new site specific fungicides have been launched in Asia. Highly effective products based on triazole chemistry (DMIs) continue to be developed, whilst azoxystrobin (Amistar®, Ortiva®) a strobilurin (QoI) fungicide, has set new standards for disease control throughout the world.

Azoxystrobin changed the paradigm for site-specific fungicides by demonstrating an unprecedented spectrum of disease control, controlling fungi from all of the major groups of plant pathogenic fungi at low use rates. Due to the combination of powerful fungicidal activity and outstanding disease control spectrum, programmes based on azoxystrobin are associated with significant yield and quality benefits. Other strobilurins have subsequently been introduced in Asia, such as trifloxystrobin.

Several new products with greater specificity for a particular pathogen group have also been introduced. An example is Switch, a preformulated mixture of cyprodinil and fludioxonil, giving excellent control of diseases caused by pathogens such as *Monilinia* spp. and *Botrytis cinerea*. Another new active ingredient is boscalid, which gives good control of pathogens such as *Sclerotinia* spp. and *Botrytis* spp. Several new products with specific activity against Oomycete pathogens have also been introduced recently, or are being developed. These include dimethomorph, cyazofamid, iprovalicarb, benthiavalicarb and ethaboxam.

An important element in the use of all site-specific fungicides is their inherent propensity to select for resistant strains of fungi. Fungicide resistance risk is usually highest in those crops under intensive cultivation, with many cropping cycles and a demand for multiple fungicide applications. Responsible resistance management practices are therefore imperative to ensure the sustainable use of fungicides. Resistance management recommendations for site specific fungicides have been developed by the Fungicide Resistance Action Committee (FRAC) to minimize the impact of resistance on crop production. To help

meet these recommendations for strobilurin (QoI) fungicides, preformulated premixtures of azoxystrobin and fungicides from different cross resistance groups are being introduced throughout the world. Field trials indicate that these premixtures offer excellent benefits to the farmer, including delaying the evolution of resistance and maintaining the excellent yield and quality benefits associated with azoxystrobin.

Concomitant with the grower's need for fungicides that improve crop yield and quality is the need to use products that have an acceptable toxicological and environmental profile. This is a key driver in the agrochemical discovery and development process, and indeed was one of the criteria used to select azoxystrobin in preference to other candidate molecules during its development.

Final Remarks

It is hoped that recent advances in technology (including high-throughput screening, genomics, molecular modelling, combinatorial chemistry, and biorational approaches) will deliver novel and improved fungicide solutions in the longer term. In the short- to medium-term, effective resistance management practices are imperative to ensure sustainable use of existing fungicide products.

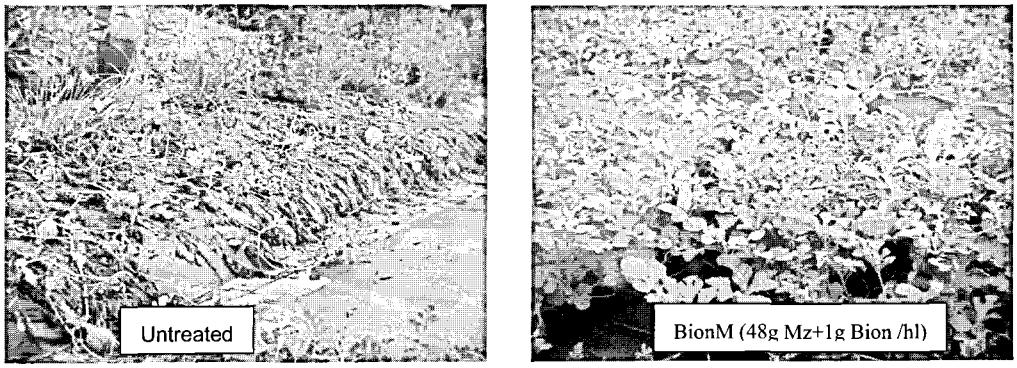

Fig 1: Efficacy of Bion M against black rot in watermelon

Fig 2: Efficacy of Amistar® against anthracnose in apple.