DEVELOPING RESISTANT VARIETIES AND INTEGRATED MANAGEMENT PACKAGE AGAINST BOTRYTIS GREY MOULD OF CHICKPEA: AN INTERNATIONAL EFFORT

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ABSTRACT

An international collaboration between Australia, Bangladesh and India is undertaking research to identify BGM resistant germplasm and to implement integrated disease management strategies in these countries. Screening in BGM nurseries has shown variability in the germplasm for disease reaction indicating that breeding may lead to varieties with increased resistance to BGM. In Bangladesh, higher yield was obtained from integrated crop management (ICM) practice compared to local farmers' practice. Training of farmers is effective and timely implementation of ICM practices will be required to achieve higher and more stable yields of chickpea in Bangladesh.

Key words: Chickpea, Botrytis grey mould, screening, breeding, integrated crop management, international collaboration

INTRODUCTION

Botrytis grey mould (BGM), caused by *Botrytis cinerea*, is an intermittent and damaging disease of chickpea (*Cicer arietinum* L.) in Australia, but is a major impediment to sustained production of chickpea in Bangladesh (Bakr *et al* 2002). In recent years the area under chickpea production in Bangladesh has declined from about 100,000 ha to 16,000 ha. The future of chickpea production in Bangladesh hinges on the development of an integrated crop management system and BGM resistant cultivars that will allow reliable production in the presence of BGM and insect pests. In Australia, BGM has receded as an economic problem following the emergence of ascochyta blight in the late 1990s as fungicides used to manage ascochyta blight have also controlled BGM. The imminent release of ascochyta blight resistant varieties, coupled with a reduced reliance on fungicides, will again make the provision of an integrated management system for BGM, including BGM resistant cultivars, a high priority.

Crop management practices that can reduce the severity of BGM in chickpea have been demonstrated in small plot trials in Bangladesh, Nepal and north-eastern India (Pande *et al* 2002). These practices include delayed sowing, wide row spacing, use of erect plant types and mixed cropping. However, there have been limited attempts to develop integrated BGM management packages by combining these various practices on an operational scale in the fields of resource-poor farmers of Bangladesh.

A collaborative project has been established between researchers in Australia, Bangladesh and India with the aim of increasing chickpea production in both Australia and Bangladesh through improved control of BGM. Two major objectives of this project are to search for improved host resistance amongst disparate germplasm sources (including annual *Cicer* species); and to implement integrated disease management strategies.

This paper discusses progress on two specific components of this international project; the screening of a wide range of chickpea germplasm against BGM; demonstration of integrated disease management packages in Bangladesh through on-farm demonstrations.

METHODS

Screening for Botrytis Grey Mould resistance.

Four hundred and seventy six genotypes, including 369 breeding lines and cultivars from Australian breeding programs, were screened in BGM field nurseries at Jessore (23° 03' N, 89° 10' W) and Ishurdi (24° 00' N, 89° 00' W) in Bangladesh in 2002-03. A sub-set of 60 entries, was also screened in a BGM field nursery at Tarahara (26° 40' N, 87° 17' W) in Nepal.

The BGM disease nursery at Ishurdi relied on natural infection of BGM but disease development was accelerated by increasing the humidity through the use of a misting system. Mist was applied for 30 minutes five times per day in February and March. The BGM nurseries at both Jessore and Tarahara, were exposed to natural disease development, receiving neither *Botrytis cinerea* inoculum nor irrigation to elevate humidity. All three BGM screening nurseries were unreplicated due to

limited quantity of seed, but the susceptible variety Nabin was repeated after every four test entries to observe disease uniformity across each experiment. Plots were 2 m long and separated from their neighbours by 35 cm, each plot was sown with 25 seeds. All plots in each nursery were scored for BGM on three occasions, the first at the start of flowering, the second and third scores were taken 10 and 20 days later respectively. Plots were scored on a 1 to 9 scale where 1 = no lesions and 9 = lesions common on all plants, more than 75% of canopy dead (Nene et.al.1981) Only the final disease score is presented in this paper as it gave the best differentiation between genotypes.

On-farm evaluation of Integrated Crop Management practices.

There were 100 comparisons of "improved practice" (ICM package) compared to "local practice" in selected upazilla of five districts in Bangaldesh (Jessore, Faridpur, Jhenidah, Magura, Rajbari). At each upazilla paired comparisons were established in side-by-side field scale plots of about 0.06 ha laid out in clusters of five around a village to give dispersed replication. In both improved and farmer practices, seed and fertilizer were hand broadcast (seed rate 50 kg/ha) on undisturbed soil, usually after harvest of transplanted aman (summer) rice, mostly between 21 November to 15 December. Seed and fertilizer were incorporated immediately by cross-wise ploughing, usually by bullock or power tiller, and laddering (leveling). For other management practices a set strategy was used for the improved practice treatment and farmers' local practice (Table 1).

Table 1. Management details of on-farm evaluations of ICM package and local practice.

Component	*Treatments*	
	Improved practice (ICM package)	*Local practice*
For BGM control		
Variety	Improved (cv. Barichola 5)	Seed obtained by farmer
Seed source	BGM-free source	Locally procured
Sowing time	Late November - early Dec	Decided by farmer
Canopy management	Canopy reduction as required	None
Fungicide spray	Acrovet MZ® or Bavistin® as required	No spray
Other management components		
Fertilizer	20 kg P/ha	None or local farmer practice
Pod borer control	Scouting for eggs and small larvae, bird perches, insecticide as required	Farmers' decision as required

RESULTS AND DISCUSSION

Screening for Botrytis Grey Mould resistance

Disease development was severe at Tarahara and Ishurdi and no seed was harvested at either site. Moderate disease developed at Jessore. Genotypic variation in disease reaction was shown in all three screening nurseries; however, the very severe disease experienced at Ishurdi meant that few entries fell outside the highly susceptible class (Table 2). Comparison of the 60 genotypes which were tested at all 3 nurseries shows that some genotypes had consistently high scores, while others had generally variable scores that included relatively low ratings at one or more sites compared to the mean of all genotypes (Figure 1). No genotypes had a relatively low score at all sites.

Earlier screening effort of chickpea germplasm, both in controlled environment and field screening at hot spot locations indicated that there was no genotype with high level of resistance (Haware and Nene 1982; Rathi et. al. 1984). While Rewal and Grewal (1989) found ICC1069 and ICC5035 as relatively resistant. Laha & Khatua (1988) also found ICC1069 as resistant. But Ahmed (1989) found only moderately resistant cultivar to BGM in his screening in Bihar state of India.

Table 2. Number of entries in five disease reaction classes in BGM nurseries at Tarahara (Nepal), Ishurdi and Jessore (Bangladesh).

Disease severity reaction		Number of entries		
Score	Class	Tarahara	Ishurdi	Jessore
1	Highly resistant	0	0	79
2-3	Resistant	0	0	212
4-5	Moderately resistant	17	28	114
6-7	Moderately susceptible	41	32	58
8-9	Highly susceptible	0	411	0

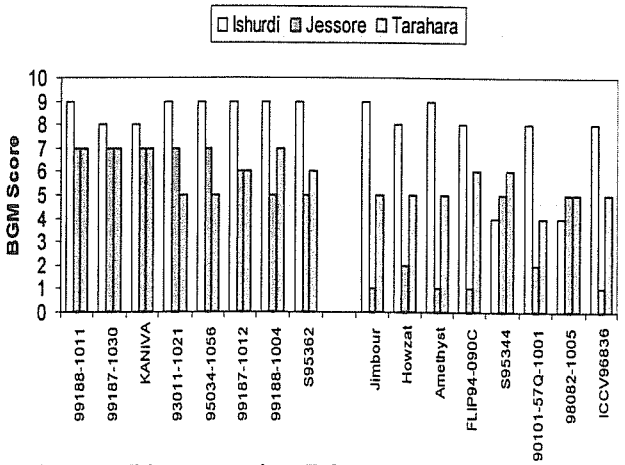

Figure 1. Disease reaction (BGM score) for the eight entries having the highest and eight entries having the lowest mean BGM score amongst the common set tested at Ishurdi, Jessore (Bangladesh) and Tarahara (Nepal).

On-farm evaluation of Integrated Crop Management system.

Widespread and severe infestations of BGM resulted from unusually frequent and heavy rain during March and early April. For example, at Ishurdi 99 mm of rain was recorded on 13 days between 11 March and 5 April and at Jessore 153 mm fell on 12 days in the same period. Three of the five replicate village level comparisons are not presented as three or more replicates were abandoned. In all except one of the five replicate village level comparisons, the improved practice plots gave a higher yield (18-194% more) than the local practice (Table 3). In 11 of the 17 on-farm comparisons where yields from all plots were available, the average yield of both production practices was less than 500 kg/ha. In some comparisons, farmers thinned particularly dense stands in an attempt to slow disease development, however this appeared to have little effect in improving yields due to the continuing wet weather and prolific vegetative growth.

Jidicious use of fungicides as a seed treatment and/or foliar spray in an integrated disease management system could be very economical and affordable to the resource poor farmer. Integrated disease management systems comprising the use of available level of host plant resistance, agronomical and cultural, chemical and biological disease control components in total or in several combinations, has been found effective in management of BGM (Pande et.al 1998).

Table 3. Mean grain yields (kg/ha) of on-farm comparisons of 'improved' practice (ICM) with 'local' practice in upazilla of five districts in Bangladesh, during 2002-03 season.

District	Upazilla	Village	Mean grain yield (kg/ha)		Increase of ICM over local practice (%)	Probability[1]
			Improved	Local		
Jessore	Bagherpara	Agra	465	330	41	<0.001
	Bagherpara	Betalpara	185	144	28	<0.05
	Sadar	Lebutala	328	263	25	<0.05
	Monirampur		1,063	707	50	<0.01
Magura	Shalikha	Hazrahati	312	264	18	<0.001
	Shalikha	Boira	620	522	19	<0.05
	Sardar	Ishakhaoda	639	479	33	<0.001
Jhenaidah	Kaliganj	Barabazar	989	966	2	n.s.
	Maheshpur	Mandirbaria	851	672	27	<0.001
Faridpur	Sardar	Ishan Gopalpur	248	206	20	<0.05
	Sardar	Kanaipur[2]	492	393	25	<0.05
	Boalmari	Kadiri	297	213	39	<0.001
	Madhukhali	Bagat-01	920	806	14	<0.05
Rajbari	Sardar	Khankhanapur-01	327	186	76	<0.01
	Sardar	Khankhanapur-02	303	105	194	<0.01
	Pangsha	Madapur-02	237	165	44	<0.05
	Pangsha	Kalikapur-02[2]	249	174	43	<0.05

1. Probability of significant treatment difference according to a two-tailed "t" test.
2. ICCL 87322 instead of Barichola 5 was used in the ICM treatment.

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Acknowledgements

We acknowledge the financial support from the Australian Centre for International Agricultural Research (ACIAR). We also acknowledge the Australian Coordinated Chickpea Improvement Program (ACCIP), Bangladesh Agricultural Research Institute (BARI), Centre for Legumes in Mediterranean Agriculture (CLIMA), ICRISAT (India) and the Department of Agriculture Western Australia for their collaboration.