control fields and individually kept in the laboratory to evaluate the level of parasitism. Cylindrical sticky traps (Romeis et al. 1996) were placed in the field at crop canopy height to monitor the parasitoid population. The weather conditions during the release trials were optimal. Mass-releasing *Trichogramma* in both crops did not lead to higher *H. armigera* egg parasitism levels compared to control fields without releases. From a total of 1383 eggs collected in pigeonpea only 31 (2.2%) were parasitized. Out of a total of 1222 eggs collected in chickpea, none was found to be parasitized. The sticky trap catches showed that the *Trichogramma* population within the field remained low throughout the trial. Only two wasps were trapped in the release field and none were caught in the control fields from five sticky traps on nine sample dates. This indicates that wasps leave the field soon after emergence.

Future research should focus on the plant factors responsible for the low parasitoid efficacy on these two crops.

Acknowledgement. We thank Mrs Jyothirmayi for her technical assistance. Support to J Romies by 'Deutsche Gesellschaft für Technische Zusammenarbeit' (GTZ) is gratefully acknowledged.

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Biotechnology

An Improvised Medium for In vitro Pollen Germination and Pollen Tube Growth of Chickpea

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In vitro pollen germination is a very convenient and effective technique to study many basic and applied aspects of pollen biology (Heslop-Harrison 1987, Kristen and Kappler 1990, Shivanna and Rangaswamy 1992). The composition of the medium used for pollen germination varies from species to species. The medium formulated by Brewbaker and Kwack (1963) has been used for pollen of a number of species including chickpea (Srinivasan et al. 1997). In our preliminary studies on assessing the feasibility of using pollen for screening genotypes tolerant to cold, we also used Brewbaker and Kwack (BK) medium. Although we recorded up to 80% pollen germination in some accessions, the response was inconsistent. Also, pollen tube growth was limited to < 200 µm in most of the genotypes. Polyethylene glycol (PEG) has been shown to improve markedly in vitro pollen germination and/or pollen tube growth in many species (Zhang and Croes 1982, Read et al. 1993, Shivanna and Sawhney 1995). To improve the medium for pollen germination and pollen tube growth in chickpea, we tested the effects of PEG. This communication gives details of the improvised medium for use by chickpea breeders.

Initial experiments were conducted with pollen of a cold tolerant accession ICC 8923 grown in a growth chamber (15°/5°C, day/night). The improvised medium was subsequently tested with many other cold tolerant as well as cold susceptible accessions. Pollen grains were collected from freshly opened flowers and used to raise sitting drop cultures (Shivanna and Rangaswamy 1992). In preliminary studies, various combinations of sucrose and PEG 8000 (Sigma®) concentrations were tested in the medium containing B/K salts. The best response was obtained in a medium containing 2.5% sucrose and 10% PEG. Thus the improvised medium contained sucrose 2.5 % + PEG 10% + boric acid 100 mg L^{-1} + calcium nitrate 300 mg L^{-1} + magnesium sulphate 200 mg L^{-1} + potassium nitrate 100 mg L^{-1}.

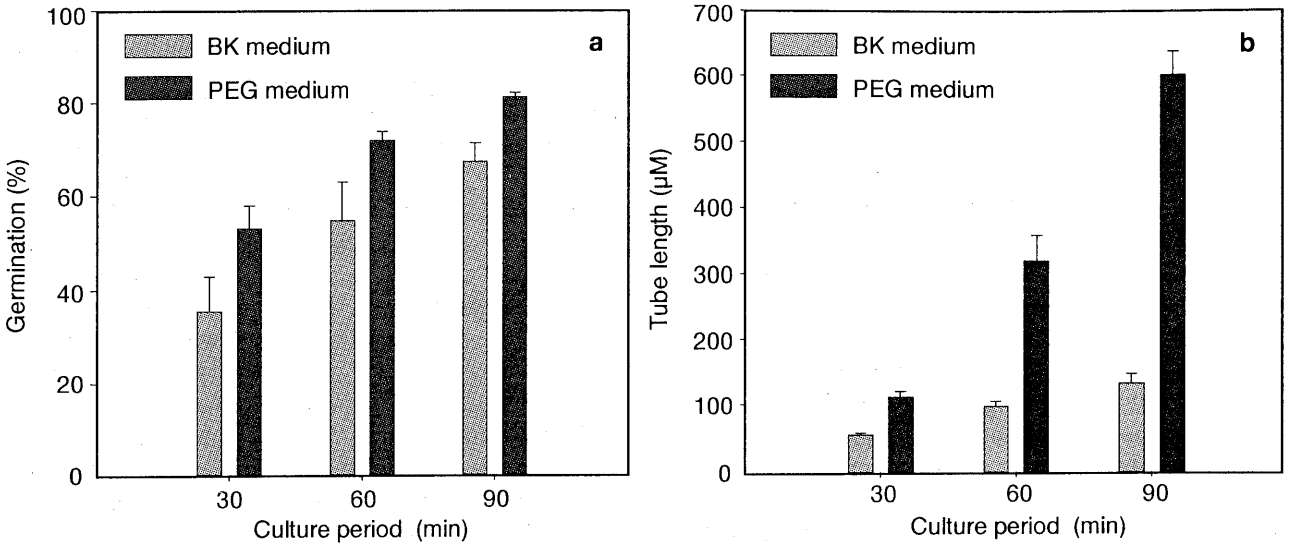

Figure 1. Pollen germination (a) and pollen tube growth (b) of chickpea accession ICC 8923 in Brewbaker and Kwack (BK) medium, and poleythylene glycol (PEG) medium.

Figure 1 presents the details of pollen germination and pollen tube growth in the BK medium and the improvised PEG medium. In the BK medium, pollen germination was generally lower than the PEG medium and pollen tube growth was largely confined to the first 60 min. There was hardly any growth beyond 90 min, reaching a mean length of 140 µm. Over 70% of the pollen tube tips showed abnormalities such as swelling, bursting, and vacuolation in 3-h-old cultures. In the PEG medium, pollen germination was consistently good and the tube growth was much faster. The tube length recorded in the PEG medium after 90 min of the culture was nearly five times more than that obtained in the BK medium. Pollen tubes were smooth, narrow, and uniform throughout their length. Pollen tube tips were normal in over 80% of the tubes, and pollen tube growth continued even after 90 min. Although exact measurements could not be made beyond 90 min because of overlapping of tubes, a few isolated pollen tubes measured 1–1.5 mm in 3 h, and up to 5 mm in cultures maintained overnight. The PEG medium was equally effective in other greenhouse/field-grown chickpea accessions and also a wild species (*Cicer judaicum*, ICCW 34) tested. Thus, the PEG medium we have standardized is more suitable than the BK medium for studies on pollen germination and pollen tube growth in chickpea. We are now using the PEG medium regularly in our studies on pollen germination in chickpea in relation to cold tolerance. For some genotypes the medium may require standardization of optimal concentrations of sucrose and PEG.

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