polymorphic forms[10]. Preliminary solid-state ^{13}C NMR spectra run on two samples crystallized from water and acetonitrile failed to show any significant changes in the carbon signals. This result is in accordance with the DSC, IR and X-ray diffraction (powder) results[10]. Further work on these lines is in progress.

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XYLANASE PRODUCTION BY *FUSARIUM OXYSPORUM* F.SP. *UDUM*

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Xyloglucans and xylans are the most common hemicelluloses. The former is the major component (21%) of the primary cell wall of plants, while the latter is present mostly in the secondary wall of woody tissues. These form a protective covering over the cellulose fibrils preventing enzymatic degradation of cellulose[1,2]. The xylanases include (i) endo-xylanase (EC 3.2.1.8) which attacks the xylan chain randomly releasing xylooligosaccharides, and (ii) β-xylosidase (EC 3.2.1.37) which attacks terminally releasing xylose residues[3].

Xylanases are used in the food processing industry for isolation of proteinaceous and other subcellular materials from plants[4], pretreatment of agricultural wastes to enhance cellulose degradation[5] by removing the overlying xyloglucan molecules, and also in paper industries to remove hemicelluloses from paper pulp to produce high grade dissolving pulps. The present paper examines xylanase production by *Fusarium oxysporum* f.sp. *udum*, causing wilt of pigeon pea.

The organism was grown in 25 ml of Mandels' medium[6] supplemented with 0.5% larch-wood xylan (Sigma Chemical Co., USA) in 100 ml Erlenmeyer flasks. The pH of the medium was adjusted to 5.2. The flasks seeded with 1 ml spore suspension (5×10^6 spores/ml) collected from culture grown on Czapek medium containing glucose were incubated at 28°C without shaking for 14 days. On alternate days the culture media were centrifuged at 10,000 rpm for 15 min at 4°C, dialyzed against several volumes of distilled water overnight at 4°C and used as the enzyme sample. All enzyme assays were carried out at 45°C and at pH 7.0, using 0.05 M potassium phosphate buffer. For endo-xylanase assay 0.5 ml of the dialyzed enzyme sample was allowed to react with 0.5 ml of substrate (0.5% larch-wood xylan) for 30 min and the release of reducing groups was measured by Miller's method[7]. The activity is expressed as μmol of xylose released/ml/min. β-xylosidase activity was assayed by monitoring the release of paranitrophenol from PNPX (para nitriphenyl β-D-xylopyranoside) (20 mM) (Sigma Chemical Co., USA). The reaction mixture containing 1 ml of enzyme and 1 ml of substrate was allowed to react for 1 hr. The reaction was stopped by adding 2 ml of 1 M sodium carbonate and 10 ml of distilled water and the absorbance of the mixture was noted at 405 nm[8]. Results are expressed as μmol of paranitrophenol released/hr/ml of enzyme.

Table 1 shows that the organism produced both endo-xylanase and β-xylosidase from the second day onwards. The activity of endo-xylanase in the growth medium increased sharply showing optimum value on the 8th day. β-xylosidase, which was also optimally active on the 8th day, had rather a slow but steady increase as compared to endo-xylanase. This could be due to the sequential mode of action of these enzymes on xylan. Chromatographic analy-

Table 1 *Xylan-degrading enzymes production by Fusarium oxysporum f.sp. udum on the Mandels' medium containing 0.5% larch-wood xylan*

Growth period (days)	Endo-xylanase (IU/ml)	β-xylosidase (μmol of p-nitrophenol/ml/hr)
2	0.28	0.81
4	2.82	4.34
6	6.47	10.36
8	9.26	24.81
10	8.31	9.17
12	7.21	6.34
14	5.86	4.36

sis of culture filtrate co-chromatographed with xylooligosaccharides showed presence of xylooligosaccharides on the chromatogram in the early phase up to 6th day, followed by xylose after 8th day.

The present organism seems to be a potent xylanase producer. Earlier work from our laboratory[9] showed that *Penicillium islandicum* produced 0.8 units of endo-xylanase and 1.2 units of β-xylosidase. Biswas *et al*[10] reported 2.24 units of endo-xylanase production by *Aspergillus ochraceus*-42 (β-xylosidase activity was not reported). *F. oxysporum* f.sp. *udum* with its 9.26 units of endo-xylanase and 24.8 units of β-xylosidase is thus a better organism for use in pretreatment of agricultural wastes, removal of xyloglucan, xylose production, clearing of fruit juices and also in paper industry.

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OCCURRENCE OF VESICULAR-ARBUSCULAR (VA) MYCORRHIZA IN ASCOCHYTA BLIGHT RESISTANT AND SUSCEPTIBLE CULTIVARS OF CHICKPEA

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VESICULAR-ARBUSCULAR (VA) mycorrhizal fungi are among the more common and widely distributed of soil-borne fungi and establish non-pathogenic symbiotic association with roots of higher plants. There are clear indications that VA-mycorrhiza can increase or decrease the general resistance of plants to pathogens[1–3]. Since mycorrhizal fungi occur naturally on most of the plant species, an attempt was made to assess the difference in mycorrhizal spore populations in soil from the root zone of some ascochyta blight (*A. rabiei*) resistant and susceptible cultivars of chickpea growing under field conditions at Pantnagar.

The experimental material included four cultivars of chickpea viz ICC 8160 and ICC 8161 showing resistant reaction equivalent to rating 3 (1–9 scale) and ICC 2664 and Annegeri showing susceptible reaction equivalent to rating 9 in the above scale. The above cultivars were obtained from the Department of Plant Breeding of this university where they were tested for their resistant reaction against Ascochyta blight (*A. rabiei*) using earlier technique[4]. VA-mycorrhizal fungal spore population from several soil samples of the root region of resistant and susceptible cultivars was studied at the time of maximum disease development. VA-mycorrhizal fungal spores were isolated by 'wet sieving and decanting' method[5] and the quantitative differences in their population were estimated by earlier method[6].