J. Indian bot. Soc. Vol. 69 (1990) 55-58

OCCURRENCE OF VESICULAR-ARBUSCULAR MYCORRHIZA (ENDOGONACEAE) IN *GRINDELLIA CAMPORUM GREENE*

O.P. SIDHU AND H.M. BEHL
National Botanical Research Institute, Lucknow
N. K. MEHROTRA
Botany Department, University of Lucknow, Lucknow

Grindelia camporum is a potential hydrocarbon producing species. Two vesicular arbuscular mycorrhiza species (*Glomum dimorphicum* and *Glomus australe*) were found to be associated with the roots of *Grindelia camporum*. Distinctness of *G. dimorphicum* from *G. mosseae* and *G. fasiculatum* has been discussed.

Key Words: Association V A M fungi, *G. dimorphicum*, *G. australe*

Many resinous plants are being considered these days as potential petro crops yielding biocrude which, after various degrees of processing and blending with other fuels, can be used for powering internal combustion engines (Hall *et al* 1982). Amongst such hydrocarbon rich plants, *Grindelia camporum* Green (family : Asteraceae) is very promising as it produces abundant glutinous exudates on the foliage and involucres. Its biomass and biocrude productivity also falls within the range expected of biocrude crops. McLaughlin *et al.* (1983) have suggested that *G. camporum* is a potential candidate species on the basis of quality vs quantity of its yield. It yields 11 tonnes per hectare biomass and has a biocrude potential similar to the other major petro crops like *Calotropis procera*, *Euphorbia lathyris* and *Chrysothamnus paniculatus*.

The resin produced by the shrub is made up of diterpene acids having physical and chemical properties similar to those of pine resins. Resins from the roots contain grindelic acid while aerial parts contain diterpenes that are related to grindelic acids (Bohlamann *et al.*, 1982).

Grindelia camporum is native of North-western Mexico and has been introduced in India and grown at National Botanical Research Institute, Lucknow (Anonymous, 1988). This species can be commercially exploited if the biomass yields are increased by selecting suitable strains and better management of agricultural practices. Association of vesicular-arbuscular mycorrhizal fungi often improves biomass yields by significantly increasing uptake of moisture (Mosse 1973; Gerdemann, 1968; Moawad, 1986) and other elements like Zn and Cu (Lambert *et al* 1979). In order to undertake research experiments on productivity of this hydrocarbon plant and on the effect of V A M fungi on its growth and biomass it was considered desirable to investigate the natural association of mycorrhizal fungi with this taxon. Survey of the literature revealed that there has been no systematic study on the association of V A M fungi on its growth and biomass it was considered desirable to investigate the natural association of mycorrhizal fungi with this taxon. Survey of the literature revealed that there has been no systematic study on the association of V A M fungi with hydrocarbon rich plant especially *Grindelia camporum.*

MATERIALS AND METHODS

Grindelia camporum plants growing in the experimental pots filled with loamy-sand soil collected from Badshahbagh, Lucknow were selected for the present investigation. Root samples along with the surrounding soil were collected from three months old plants of *G. camporum*. Terminal feeder roots attached to lower order roots were washed carefully and cleared with 10% KOH followed by H_2O_2. The roots were then washed with 5N HCl, stained with 0.05% trypan blue and mounted in lactophenol following the method described by Phillips and Hayman (1970). The spores of V A M fungi were isolated from the soil surrounding the roots by wet sieving and decantation by the method of Gerdemann and Nicolson (1963).

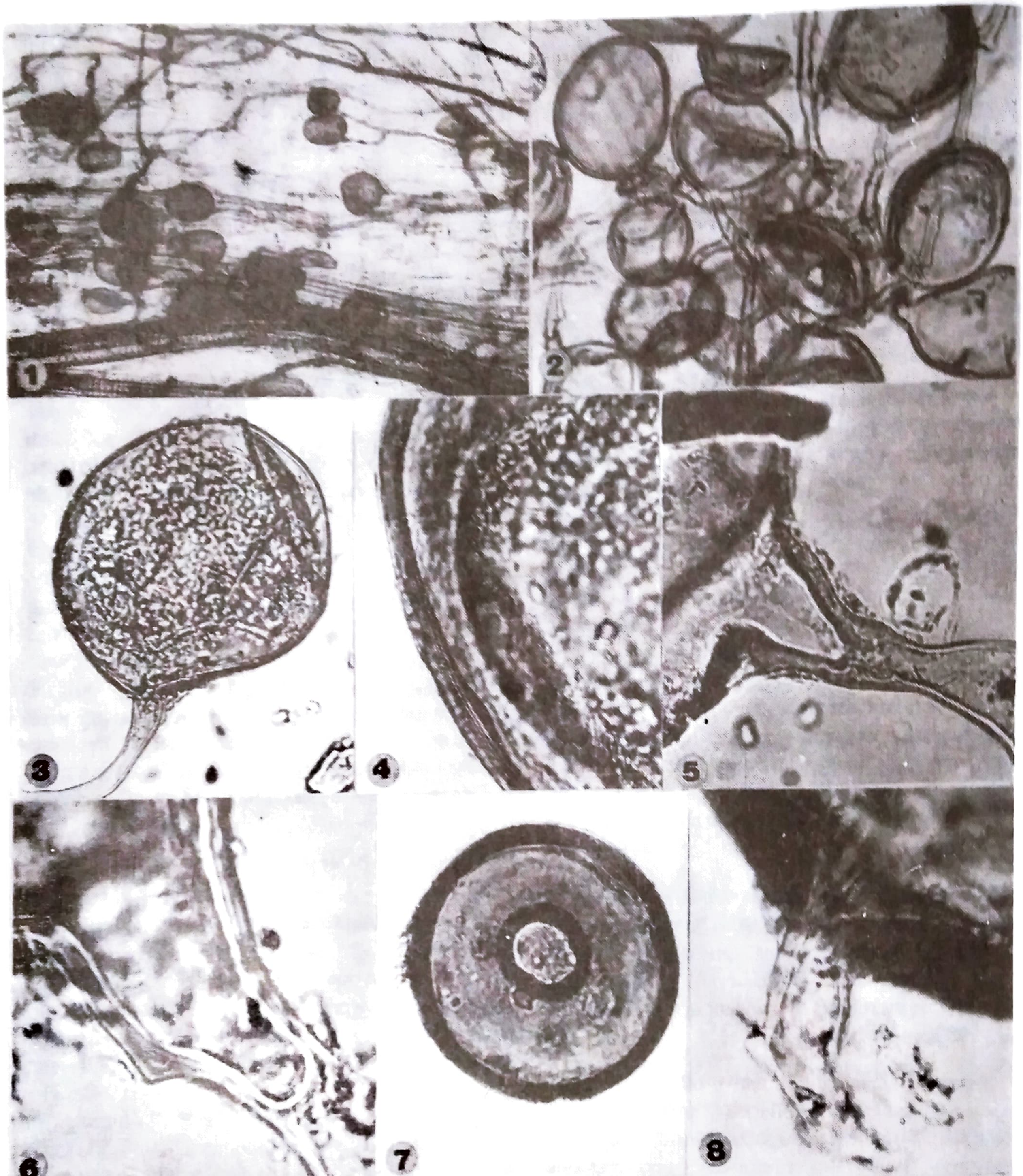

Fig. 1: Cleared and stained root of *Grindelia camporum* showing vesicles and mycelial network of endomycorrhizae. Fig. 2: Cluster of Chlamydospore of *G. dimorphicum*. Fig. 3: Single mature chlamydospore of *G. dimorphicum*. Fig. 4: Same as in Fig. 3, a portion magnified showing three wall layers. Fig. 5 & 6: Portion of spore of *G. dimorphicum* showing point of attachment. Fig. 7: Chlamydospore of *Glomus australe* showing double wall layers; inner wall is thicker than the outer wall. Fig. 8: Same as in Fig. 7; a portion magnified to show point of attachment. There is an open pore in the subtending hypha and the inner wall is continuous up to the subtending hypha.

RESULTS AND DISCUSSION

Two vesicular-arbuscular mycorrhizal fungi were found to be associated with the roots of *G. camporum* (Fig. 1). They are described below.

Spores appeared in loose clusters in the soil (Fig. 2). Spores in the clusters were globose to sub-globose, (41.60)62.40(83.20) µm in diameter. Sporogenous hypha of the clustered spores were straight, light yellow to brown. Chlamydospores (Fig. 3) were yellow to brown; globose to sub-globose (95.65)83.02(270.4) µm in diameter. The spores were three walled (Fig. 4) with outer wall thick and hyaline, inner light yellow to reddish brown, middle wall laminate and light yellow in colour. The points of attachments of spores (Fig. 5-6) were cylindrical to flared and (8.32)10.40(12.48) µm in thickness. Occassionally, a septum was present a little distance away from the point of attachment. The mycorrhizal fungi was identified as *Glomus dimorphicum* (Schenck and Perez, 1987; Boyetchko and Tewari, 1986).

In the second case, chlamydospores were globose to sub-globose, dark brown, and were (110.24)180.96(251.68) µm in diameter. The spore wall was double layered, outer hyaline and pale yellow; inner thick, light or dark brown. The subtending hyphae at the point of attachment measured (12.48)18.72(24.96) µm. The pores in the subtending hyphae were open and the inner wall continues up to the subtending hypha. The V A M fungus (Figs. 7-8) was identified as *Glomus australe* (Schenck and Parez, 1987).

The spores of *G. dimorphicum* are dimorphic and occur singly or in loose, often radial clusters in the soil. The species resembles *G. mosseae* (Nicol. & Gerd.) Gerd. & Trappe (Gerdemann and Trappe, 1974). Though the septa are present in sporogenous hyphae of both species, presence of occulated point of attachment in *G. dimorphicum* differentiates it from *G. mosseae*. Also unlike that of *G. mosseae*, inner walls of spores of *G. dimorphicum* are thin, with a thich middle laminate wall and a relatively thick outer hyaline wall (Boyetchko and Tewari, 1986). The spores of *G. dimorphicum* also resemble those of *G. aggregatum* Schenck & Smith (Schenck and Smith, 1982) and *G. fasiculatum* Gerd. & Trappe (Gerdemann and Trappe, 1974) but differ in being much larger and in having an outer hyaline wall.

Further experimentation to ascertain the rolé of these fungi in promoting biomass yields of *G. camporum* particulary in deficient and degraded soils is being undertaken by the authors.

Authors are grateful to Dr. G. S. Srivastava for suggesting and providing plant material for the present investigation.

REFERENCES

Anonymous 1988 In *Grindelia camporum* Greene a hydrocarbon rich plant *Newsletter* Bio Energy Soc India **4**(2) 28-29.

Bohlmann F, M Ahmed, N Borthakur, M Watlmeyer, J Jakupovic, R M King & H Robinson 1982 Diterpene related to grindelic acid and further constituents from *Grindelia* species *Phyto chem* **21** 167-169.

Boyetchko S M & J P Tewari 1986 A new species of Glomus (Endogonaceae zygomycotina) mycorrhizal with barley in Alberta *Can J Bot* **64** 90-95.

Gerdemann J W 1968 Vesicular-arbuscular mycorrhiza and plant growth *Ann Rev Phytopath* **6** 397-418.

Gerdemann J W & T H Nicolson 1963 Spores of mycorrhizal *Endogone* species extracted from soil by wet sieving and decanting *Trans Br Mycol Soc* **46** 235-244.

Gerdemann J W & J M Trappe 1974 The Endogonaceae in the Pacific Northwest *Mycologia Mem* **5** 1-76.

Hall D O, G W Barnard & P A Moss 1982 *Biomass for energy, in the developing countries-current role, potential probelms, prospects* 54-58 pp. Pergamon Press Oxford .

Lambert D H, D F Baker & H Cole 1979 The role of mycorrhizae in the interaction of phophorus with Zinc Copper and other elements *Soil Sci Soc Am J* **43** 976-980.

McLuaghlin Steven, P Barbara, E Kingslover & Joseph J Hoffmann 1983 Biocrude production in arid lands *Economic Botany* **37**(2) 150-158.

Moawad A M 1986 The problems of using vesicular-arbuscular (VA) mycorrhiza for supplying phosphate to *plants Plant Research & Development* **23** 68-77.

Mosse B 1973 Advances in the study of vesicular-arbuscular mycorhiza *Ann Rev Phytopathol* 11 171-196.

Phillips J M & D S Hayman 1970 Improved procedure for cleaning and staining parasitic and vesicular-arbuscular mycorrhozal fungi for rapid assessment of infection *Trans Br Mycol Soc* 55 158-161.

Schenck N C & G S Smith 1982 Additional new and unreported species of mycorrhizal fungi (Endogonaceae) from Florida *Mycologia* 74 77-92.

Schenck N C & Y Perez 1987 *Manual for the identification of VA-mycorrhizal fungi* 191-192 pp. Univ of Florida Gainevelle Florida.