

Baluchistan sulphur dust and leave 11.5 acres untreated.

Treatment	Percentage of smut	
	Delhi	Karnal
Control	1.20	1.44
Pure sulphur	0.08	0.10
Formalin dust (6 per cent. formalin on charcoal dust)	0.00	0.04
Agrosan G.	0.01	0.08
Baluchistan sulphur	0.05	0.08

Two different lots of seed were used, one from Rohtak and the other from Karnal, both naturally infested with grain smut spores. The percentages of grain smut in the resulting crops were as follows:

Area in acres	Seed	Treatment	Percentage grain smut
1	Rohtak	Treated	Nil
11.5	Karnal	"	Nil
11.0	Rohtak	Untreated	9.8
0.5	Karnal	"	2.1

It will be noted that our sulphur was hand-picked before grinding and so brought up to 75 per cent. sulphur. It is of great interest to us that Kulkarni has obtained comparable results with the unpicked material.

Mycology Section,
Imperial Agricultural
Research Institute,
New Delhi,
January 14, 1944.

G. WATTS PADWICK.
B. B. MUNDKUR.

NEOVOSSIA INDICA IN CULTURE

DURING the course of an investigation on the germination of the chlamydo-spores of *Neovossia indica* (Mitra) Mundkur, the slides on which they were germinating were inverted over the surface of potato agar in petri-dishes and the sporidia allowed to drop on it. Every precaution to avoid contamination was taken. The dishes were incubated at 15° C. for seven days, at the end of which period small white colonies became manifest in most of the dishes. The colonies consisted of thick mats of much branched mycelium and numerous secondary sporidia.

On transfers being made, it was noted that the organism can grow well on potato dextrose agar and in three per cent. malt extract solution. The colonies are white, powdery, brittle, crustaceous, umbonate, with dendritic margins, and spread rather slowly. A temperature of 18° C. has been found to be suitable for their growth. The mycelium coils in a peculiar manner, branching, rebranching and producing secondary sporidia, singly and at intervals. The opposite sides of the test tubes or the upper lids of the petri-dishes, as the case may be, get coated with secondary sporidia which are violently discharged. The secondary

sporidia and the mycelium appear to be entirely monocaryotic.

Further cultural studies on the behaviour of these isolations and their ability to infect the host are in progress.

Mycology Section,
Imperial Agricultural
Research Institute,
New Delhi,
January 20, 1944.

C. S. RAMAMOORTHY.
B. B. MUNDKUR.

DEVELOPMENT OF THE EMBRYO-SAC OF ZIZYPHUS JUJUBA LAMK.

THE development of the embryo-sac of *Zizyphus sativa* was investigated by Chiarugi (1930) and he found an *Allium*-type of embryo-sac in this species. Srinivasachar (1940), on the other hand, has recently reported the *Normal*-type of embryo-sac in *Z. Jujuba* and *J. anoplia*. I have reinvestigated the embryo-sac of *Z. Jujuba* and find myself unable to agree with the observations and conclusions of Srinivasachar. Even after examining numerous preparations, I have been unable to observe the formation of a tetrad of megaspores from the megaspore-mother-cell in any case. The megaspore-mother-cell gives rise only to a dyad. Both the dyad cells generally become binucleate, but no cell-walls are laid between these nuclei. The nuclei of the chalazal dyad cell then undergo two more mitotic divisions and form an eight-nucleate embryo-sac. The development of the embryo-sac in *Z. Jujuba*, therefore, is clearly of the *Allium*-type, as reported previously by Chiarugi (1930) in *Z. sativa*.

Another interesting feature of megasporogenesis in *Zizyphus Jujuba* is the very frequent occurrence of multiple embryo-sacs. As many as six or seven embryo-sacs have been observed in one ovule. These generally result from the simultaneous development of several megaspore-mother-cells, but sometimes multiple embryo-sacs also arise from the development of both the dyad cells derived from a single megaspore-mother-cell.

Thanks are due to Dr. A. C. Joshi for his kind interest.

T. N. J. College,
Bhagalpur,
December 20, 1943.

L. B. KAJALE.

1. Chiarugi, A., *Nuovo giorn. bot. Ital.*, N. S., 1930, 37, 287-312. 2. Srinivasachar, D., *Proc. Ind. Acad. Sci.*, B, 1940, 11, 107-16.

A NOTE ON THE STRUCTURE OF THE PETIOLE OF AN ANOMALOUS LEAF OF HELIANTHUS ANNUUS, LINN. (COMPOSITÆ)

TRANSVERSE sections of the petiole of an abnormal bilobed leaf of *Helianthus annuus* Linn. showed in addition to the normal vascular bundles in an arc, several internal bundles in line with some of the normal ones. In general outline the petiole is dorsoventrally symmetrical at the base, but it becomes gradually radially symmetrical as it reaches the lamina region. Resin ducts are present in the parenchymatous cortex of the abaxial side only. They are arranged in the form of an arc. According to

Haberlandt,¹ in the petiole of Sunflower every vascular bundle is subtended by crescentic group of oil passages, both on its inner and on its outer side. In the present case some of the vascular bundles of the outer arc only are subtended by resin ducts on their outer side only. Structurally the resin ducts consist of seven to eleven secretory cells and one sheathing layer. The number of resin ducts vary from 13 to 19. There is no visible endodermis and pericycle.

There is the usual arc of collateral bundles. Some of them have internal bundles of various ages and sizes. The number of the internal bundles, in association with a normal bundle, may be more than one in some cases. The internal bundles arise from pith cells situated opposite to the protoxylem of the normal bundles and develop into reversed collateral bundles, quite independent of the outer normal bundles. They appear to develop after the normal bundles. They sometimes arise opposite to the medullary rays, or in the medullary rays of the normal arc. In the medullary bundles the position of the xylem and phloem is not changed as in the internal bundle. These internal bundles are also collateral and show inverse orientation of the xylem and phloem but some are composed of phloem or xylem only. The direction in which the protoxylem elements point and the amount of xylem and phloem formed, vary in different internal bundles. Occasionally two bundles are found touching each other by their xylem or phloem faces. This gives an impression of a normal bundle with an inversely oriented internal bundle. This may be due to branching of individual bundles and to anastomoses taking place between bundles. The single bundle gradually divides itself into two which then rotate in such a way as to lie opposite to each other and for a short distance touch by their xylem or phloem faces before becoming entirely separated.

Two types of anomaly in the structure of petiole in general are recorded by Solereder.² The occurrence of "rayed bundles" is one; while the other is "true concentric or hemiconcentric bundles". The Compositæ represent one of the natural orders, many members of which exhibit internal or medullary phloem in their stems. Worsdell³ in his study of origin and meaning of medullary (intra-xylary) phloem in stems of dicotyledons has investigated many Compositæ plants. He found complete absence of medullary strands in the petiole of seven species of Rudbeckia and of Dahlia. Of the tribe Helianthoidæ only in the petiole of *Echinacea purpurea* Moench., he observed the scattered disposition of the bundles. According to Thoday,⁴ "in the petiole of a large leaf of Sunflower, there are a number of small bundles, besides the three principal ones. These small bundles appear to anastomose in rather intricate fashion and one or two large ones unite with two lateral bundles. In the base the remainder cluster round the principal bundles as they diverge. Many of the smallest bundles consist, even in the case of a matured leaf, of phloem only and in others the xylem dies out in the normal region."

The phylogenetic or physiological significance of the internal bundles has been discussed by several authors as Worsdell,³ Maheshwari and

Singh,⁵ Wurke,⁶ Alexandrov and Alexandrova,⁷ and Hartwich.⁸ According to Worsdell³ they represent a vestigial structure, the remnant of a former system. Maheshwari and Singh⁵ and Wurke⁶ are of opinion that they are of an advanced character, the species with higher chromosomes being generally found to possess them and those with the lower numbers lacking them. Alexandrov and Alexandrova⁷ and Hartwich⁸ also regard them as derived. It may be quite possible that the extra bundles are developed in response to nutritive demand.

Bahauddin College,
Junagadh,
September 21, 1943.

G. A. KAPADIA.

1. Heberlandt, G., *Physiological Plant Anatomy*, 1928, p. 525 (Macmillan & Co., London), 2. Solereder, H., *Systematic Anatomy of the Dicotyledons*, 1908, 1 & 2. 3. Worsdell, W. C., "The Origin and Meaning of Medullary (Intra-xylary) Phloem in the Stem of Dicotyledons. II. Compositæ," *Ann. of Bot.*, 1919, 33, 421. 4. Thoday, D., "On the Organization of Growth and Differentiation in the Stem of Sunflower," *Ibid.*, 1922, 36, 489. 5. Maheshwari, P. and Singh, B., "On the Internal Bundles in the Stem of *Rumex patientia*, L.," *Proc. Ind. Acad. Sci.*, B., 1942, 15, No. 3, 153-57. 6. Wurke, H. (cited by Maheshwari and Singh), 1933. 7. Alexandrov, W. G., and Alexandrova, O. G., *Ibid.*, 1926. 8. Hartwich, W., *Ibid.*, 1936.

A PODOSTEMAD FROM KUMAON (CENTRAL HIMALAYAS)

MEMBERS of the family Podostemonaceæ have been recorded in this country from South India, Assam, Eastern Himalayas (cf. Hooker¹ and Willis²) and recently Haines³ has described one species (*Lawia zeylanica*) from Orissa. In the Himalayas, there are no records of Podostemonaceæ west of Darjeeling. The collection of a podostemad from Kumaon is thus of interest in connection with the geographical distribution of the family.

The plant was found growing closely attached to large stones in the bed of the Kosi river at Chananda (29.46 N. and 79.38 E.), about 16 miles from Almora and 4,500 feet above the sea-level, in the months of August and September. The exact spot can be located by its situation opposite to the Gandhi Ashram of Chananda. On comparison with the other members of the family, it is seen that this podostemad belongs to the genus *Zeylanidium* Tul., described as a subgenus of *Hydrobryum* Endl. by Willis² in his account of the Podostemonaceæ of India and Ceylon. The genus *Zeylanidium* at present includes three species, *Z. olivaceum* (Gardn.) Engl., *Z. lichenoides* (Kurz) Engl. and *Z. Johnsonii* (Wight) Engl. The present material from Kumaon does not appear to agree with any one of these and is to be regarded as a new species.

Rae Bareilly, and
Benares Hindu University, M. S. RANDHAWA.
January 15, 1944. A. C. JOSHI.

1. Hooker, J. D., *Flora of British India*, 1886, 5. 2. Willis, J. C., "A Revision of the Podostemonaceæ of India and Ceylon", *Ann. Roy. Bot. Gard. Perad.*, 1902, 1, 181-250. 3. Haines, H. H., *Botany of Bihar and Orissa*, 1924, 5.