$$G_3 = \begin{vmatrix} 22 & 23 & 24 \\ 32 & 33 & 34 \\ 42 & 43 & 44 \end{vmatrix}, \quad G_4 = \det. |g^{ij}|,$$

with ij standing for g^{ij}.

As det. $|g_{ij}| = 1\ G_4 \neq 0$, equation (9) implies

$$(a)\ G_2 = 0,\ (b)\ G_3 = 0 \text{ or } (c)\ G_2 = 0,\ G_3 = 0, \text{ etc.} \tag{10}$$

It is interesting that if any of the three conditions in (10) is satisfied Rosen tensor is continuous across S irrespective of $g_{ij,44} \neq 0$.

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* In case of a scalar $f_{,ij} = f_{,ji}$.

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A NOTE ON THE OCCURRENCE OF TIN-BEARING RARE-METAL PEGMATITES IN THE BENGPAL SERIES (PRECAMBRIAN), GOVINDPAL-CHIURWADA-MUNDVAL AREA, BASTAR DISTRICT, M.P.

THE present note records the occurrence of tin-bearing rare-metal pegmatites from the Bengpal series. Tin-bearing rare-metal pegmatites, cassiterite-quartz, cassiterite-silicate and cassiterite-sulphide are the four main tin-ore associations recognised by Lugov[1].

The tin-ore association of Govindpal (18° 42′ : 81 54′), Chiurwada (18° 44′ : 81° 53′) and Mundval (18° 39′ : 81° 56′) area of Konta tahsil, Bastar district, M.P., is placed in "tin-bearing rare-metal pegmatite association" on the basis of typomorphic trace and ore elements—Li, Rb, Cs, Be, Ta, Nb, Sn; minerals present in the pegmatite-clevalandite, quartz, muscovite, lepidolite, cassiterite, magnetite, tantalite, spodumene, amblygonite, fluorite, beryl; and their occurrence in Precambrian metasediments of the Peninsular shield.

The Bengpal metasediments of Precambrian age with associated basic sills have suffered granite tectonism, as seen in the vicinity of Paliam, and emplacement of pegmatites in the metabasics[2].

The pegmatites are simple as well as complex. They occur in swarms. Of the many pegmatites occurring in the area only a few are tin-bearing.

The pegmatites are very irregularly zoned. The bulk composition of pegmatites is lithophilic as evidenced from the mineralogy. Tantalum and niobium are present. Apparently, fluorine, along with other mineralizers (water), are the main transporting agents in the pegmatite process. Sulphides including stannite are practically absent. Most of the rare-metal mineralisation (especially tantalum and tin) is restricted to the albite and greisen zones.

The tin-bearing rare-metal pegmatites are of hypabyssal high-volatile type and were formed by the pegmatitic-pneumatolytic processes.

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OCCURRENCE OF SPIROPLASMAS OF TWO SEROGROUPS ON FLOWERS OF THE TULIP TREE (*LIRIODENDRON TULIPIFERA* L.) IN MARYLAND

SPIROPLASMAS and mycoplasmas have been reported to occur on the surfaces of flowers of healthy plants in nature[1-8]. Some of the spiroplasmas found on flowers are serologically closely related to a strain pathogenic in honey-bees and may induce disease in bees in nature[3,5,7,8]. Other spiroplasma strains from flowers are unrelated or only distantly related to each other and to the honey-bee pathogen[2,5]. At least three serologically distinct groups have been identified among the flower-inhabiting spiroplasma strains[5]. Spiroplasmas in one of these groups, the serogroup II strains have been found on the flowers of tulip tree (*Liriodendron tulipifera* L.) growing in Maryland[9], whereas serogroup III strains have been found only on flowers of tulip trees growing in Connecticut[9]. The geographical distribution of spiroplasma strains on flowers of *L. tulipifera* has not yet been extensively investigated; but results reported

here indicate that the serogroup II and serogroup III strains can occur on flowers of tulip tree in overlapping geographical ranges.

During May and June 1978 flowers were collected from healthy trees of *L. tulipifera* growing on the U.S. Department of Agriculture's Beltsville Agricultural Research Center, Beltsville, MD. Flowers were collected in plastic bags without contact with the hands. In the laboratory, flowers were soaked for 30 min in 5 ml of a sterile culture medium described elsewhere[2], without the contact of the cut tissue surfaces with the medium. The medium was then passed through a sterile 0·45 μm (pore diameter) Millipore filter, and 0·2 ml of this filtrate was placed into each of 4–5 tubes each containing 5 ml of fresh sterile medium and inocubated at 30° C.

Several isolations were also attempted from honey bees, as it has been shown[7] that spiroplasmas induce a fatal systemic disease in the bees. Bees were collected in sterilized bottles and kept for 30 min at about 4° C to immobilize them. The honey-bees were then placed into sterile medium and cut into two or three sections and soaked for 20 min. The medium was then passed through a sterile 0·45 μm (pore diameter) Millipore filter, and the tubes of sterile medium were seeded with filtrate and incubated at 30° C.

A color change in the phenol red indicator in the medium indicated acid production and growth. A representative sample of each culture was examined daily at 1250× by dark-field microscopy. The presence of spiroplasmas was readily determined in this manner. Spiroplasma multiplication was detected after 4 days of incubation, and transfers were immediately made to fresh sterile medium. After 8 to 10 subcultures, a given isolate was filter-cloned three times to ensure that a pure strain was obtained. For filter cloning, the culture was passed through a 0·2 μm Millipore filter, and agar (1%) medium was seeded with high dilutions of filtrate. After incubation, a single colony was picked from the agar surface and placed in the broth medium. The process was repeated twice. The morphology of individual organisms was observed by dark-field microscopy and shape of colonies on agar medium was examined by a dissecting microscope.

Spiroplasmas were isolated from 2 of 12 flowers and from 4 of 20 honey-bees. All isolates grew well at 30°, 34° and 37° C. No growth occurred in serum-free medium. Colonies on serum containing agar medium lacked a "fried egg" shape; each consisted of a granular center surrounded by smaller submerged or surface "satellite" colonies. Broth and agar cultures contained helical organisms with dimensions previously reported for spiroplasmas[10,11].

An isolate from a tulip tree flower was designated as strain B-B-1, and serological disc growth inhibition tests[12] were performed to identify the strain. No reaction was observed with antiserum against the serogroup I strains (*Spiroplasma citri*) (Maroc, R8A2), corn stunt spiroplasma (I-747) and honey-bee spiroplasma (AS 576), or against the spiroplasma serogroup II strain 23–6 (the previously isolated Maryland tulip tree strain). Growth was inhibited by antiserum against strain SR 3 of serogroup III, which indicates the sharing of antigenic determinants between strain B-B-1 from Maryland and strain SR 3 from Connecticut.

This brief study confirms that a spiroplasma occurs in honey-bees in Maryland[7]. It further confirms that spiroplasmas are found on the surfaces of flowers of apparently healthy plants[1,2,4,6,9], and it provides evidence that serologically distantly related or unrelated spiroplasma strains; *e.g.*, strain B-B-1 and strain 23–6 can occur on flowers of the same plant species in overlapping geographical regions. It will be of interest to learn more about the geographical ranges and interrelationships among spiroplasmas that occur in flowers. We suspect that spiroplasmas may be widespread in nectar-feeding insects and in nectar of flowers in many regions of the world.

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STUDIES ON THE INTERNAL STRUCTURE OF LEMON LEAVES AS INFLUENCED BY PLANT GROWTH REGULATORS

Introduction

THE concept of use of different plant growth regulators to obtain higher percentage of fruitset and yield is not a new one. But the success depends on the nature of growth regulators, its appropriate doses and many other environmental factors along with the plant characteristics like—species, variety, etc. The present paper envisages a report on anatomical studies of lemon leaves as influenced by plant growth regulators.

Materials and Methods

Experimental materials for the anatomical studies of lemon [*C. limon* (L.) Burm.] leaves were collected randomly from the twigs marked for studying the effect of growth regulators on set and retention. Microscopic studies were made on the internal structure of the leaves of various treatments. The treatments were:

(1) GA — 5, 10, 20 and 40 ppm
(2) NAA —25, 50, 100 and 200 ppm
(3) 2,4-D — 5, 10, 20 and 40 ppm

Leaf samples of 1 sq.cm were taken from the central part of the 3rd and 4th leaves, about 0·5 cm away from the main vein. Free hand sections were made after clearing (with solutions of $CaCl_2$ and K_2CO_3) and washing. The thickness of the leaf lamina, palisade and spongy parenchyma were measured separately. Measurements were made with ocular micrometer and for each treatment average was made from 20 measurements.

Results

Leaf thickness was greatly influenced by the application of NAA (100 and 25 ppm), GA (40, 10 and 5 ppm) and 2,4-D at 20 ppm which as revealed by the separate measurements of palisade and spongy parenchyma, is mainly due to the higher development of spongy tissues (Table I). Different growth regulators influenced the elongation of palisade parenchyma tissue in leaves at different concentrations (Ga—5 ppm, NAA—50 ppm and 2,4-D 20 ppm). These differences are understandable, as the cell divisions cease when the leaf is still very small. The application of different growth regulators affect mainly the enlargement of cells, rather than their division.

Discussion

Microscopic studies of tissues of the leaves treated with various growth regulators revealed that almost all the treatments caused an increase in the thickness of leaf. This fact indicates that the growth regulators under study are effective in stimulating the increase of cell size of even in the semi-mature leaves of citrus. The measurements of both palisade and spongy parenchymatous tissues indicate that while in some of the treatments the palisade parenchymatous tissue had developed more, in some other cases, more marked development took place in the spongy parenchyma. It is already known that the light absorption potentiality of leaves and photosynthetic activity are partially correlated with the internal tissue development of the leaves; thicker leaves with better developed and compact palisade tissue usually absorb more radial energy in comparison to thinner leaves with loose tissue systems[1-3]. In addition to this, as chloroplasts are located in the leaf parenchyma cells, and as the parenchymatous cells also act as the storage cells for photosynthates at the initial stage, the degree of development of the leaf tissues indirectly effect their photosynthetic behaviour and potentiality.

TABLE I

Effect of different growth regulators on the internal structure of leaves

Treatments	Concentrations in ppm	Thickness in μ		
		Leaf lamina	Palisade parenchyma	Spongy parenchyma
Control		206·17	67·77	121·23
GA	5	228·79	75·81	131·65
	10	226·16	61·07	145·90
	20	206·01	57·17	133·27
	40	238·84	64·74	153·41
2,4-D	5	207·68	57·67	127·65
	10	216·97	57·67	137·86
	20	224·31	73·11	132·35
	40	214·05	55·83	137·59
NAA	25	230·68	60·84	148·93
	50	216·75	74·73	125·65
	100	244·99	65·44	156·00
	200	210·92	64·53	127·92
SEm ±		1·75	0·91	2·07
C.D. at 5%		4·96	2·58	5·82