Lfd. Nr.	Sorte	Herkunft	Sortiments-Nr.
Lycopersicon esculentum Mill. convar. *fruticosum* Lehm. provar. *speciosum* Lehm.			
311	Alaska	O. J. Olson & Sons, A. B., Hammenhög	LYC 236
312	Bounty	W. Attle Burpee, Seed Co., Philadelphia	LYC 195
313	Busktomat	O. J. Olson & Sons, A. B., Hammenhög	LYC 238
314	Conserva	Botan. Garten, Bukarest	LYC 212
315	Early Chatham	Service Botanique, Ariana, Tunesien	LYC 239
316	Gem	Van Waveren & de Bres, K. G., Weißenfels	LYC 241
317	Mary Glowe	Sortenamt für Nutzpflanzen, Vieselbach	LYC 210
318	Meteor	Dominion Dept. of Agricult., Ottawa	LYC 237
319	Niedrige Busch	Van Waveren & de Bres, K. G., Weißenfels	LYC 228
320	Olomoucké Nizké	Forschungsinstitut für Gemüsebau, Olomouc	LYC 364
321	Précoce de Chatem	Institut für Agrobiologie, Greifswald	LYC 431
322	Roter Zwerg	Institut für Obstbau, Prussendorf (Kr. Bitterfeld)	LYC 223
323	Viktor	Lehr- und Versuchsanstalt, Geisenheim (Rheingau)	LYC 106
324	Voctor	Institut für Pflanzenzüchtung, Quedlinburg	LYC 240
Lycopersicon esculentum Mill. convar. *scopigerum* Lehm. provar. *scopigerum* Lehm.			
325	Früher Prinz Borghese	Gut Wulfsdorf	LYC 117
326	Lena	IHAR, Warschau	LYC 29
327	Riesentraube	Sortenamt für Nutzpflanzen, Vieselbach	LYC 30
328	Blondköpfchen	E. Benary, Erfurt	LYC 31

Sämtliche 328 Tomatensorten erwiesen sich als hochanfällig.

Diskussion

Von den sieben in der Einleitung schon erwähnten Sorten, die bei früheren Infektionsversuchen befallsfrei blieben, gehören die beiden Sorten „Sutton's Every Day" und „Pierette" zu dem von uns geprüften Sortiment (Nr. 138 und Nr. 239) und sind hochanfällig. Ob die beiden Sorten „Grosse Lisse" und „Mikado" mit den hochanfälligen Sorten „Jaune Grosse Lisse" (Nr. 34) bzw. „Mikado, Scharlachrot" (Nr. 272) sowie „Mikado, Violettrot" (Nr. 283) identisch sind, ließ sich nicht feststellen. Die Sorten „Buckley", „Sutton's Maincrop" und „Abondance" schließlich scheinen nicht mehr zu existieren.

Auf Grund der Tatsachen, daß sich auch angeblich resistente Sorten — so weit sie noch vorhanden sind — als hochanfällig erwiesen und sich unter der großen Zahl der bisher noch nicht geprüften Sorten keine einzige resistente Sorte fand, glauben wir annehmen zu können, daß die Tomate trotz ihrer großen Mannigfaltigkeit für den Erreger des Kartoffelkrebses generell anfällig ist.

Zusammenfassung

Es wurden 328 Tomatensorten auf ihr Verhalten gegenüber *Synchytrium endobioticum* geprüft. Sämtliche Sorten erwiesen sich als hochanfällig.

Summary

328 tomato varieties were tested for their reaction to *Synchytrium endobioticum*. All varieties were shown to be highly susceptible.

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Cyto-morphological studies on some species and species hybrids in the genus *Sorghum*

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With 10 Figures

SNOWDEN (1935) recognized a group of *Sorghums* which is characterized mainly by their glabrous or lightly pubescent nodes, whorled and divided panicle branches. Such species have been treated as a unit and are grouped under *Eu-Sorghums*. The innumerable varieties and forms met with in this sub-tribe constitute a great reservoir of still unexplored variation. Hence, there have been a considerable controversy concerning the natural and sound classification to be adopted in this material and to the taxonomic status to be given to different entities as also regarding the evolutionary relationship amongst them.

A thorough study of species and species hybrids are essential if they are to be successfully utilized in a breeding programme. The interspecific crosses within the *Eu-Sorghums* made for cytological analysis have been few. Due to lack of suitable techniques for obtaining prophase stages, all the earlier reports

Table 1. *Showing the morphological characteristics of Parents and Hybrids.*

Characters	*S. nervosum*	*S. nervosum* × *S. vulgare*	*S. vulgare*	*S. nervosum* × *S. melaleucum*	*S. melaleucum*	*S. nervosum* × *S. sudanense*	*S. sudanense*	M. S. Kafir	M. S. Kafir × *S. arundinaceum*	*S. arundinaceum*
Height (cms)	185	238	290	282	180	230	183	106	201	192
No. of leaves	9—11	10—12	12—14	31—15	10—12	12—14	10—12	10—11	10—12	10—12
Length of the leaf 9 (cms)	69.8	72.5	70.5	70.6	67.8	68.5	70.4	70.5	72.5	68.6
Breadth of the leaf (cms)	6.7	7.0	5.5	7.2	7.5	6.9	5.8	6.9	6.6	6.5
Inflorescence	Semi-compact	Loose	Loose	Semi-compact	Compact	Loose	Loose	Compact	Semi-compact	Loose
Pedicillate florest	Sterile	Sterile	Sterile	Sterile	Sterile	Staminate	Staminate	Sterile	Fertile	Fertile
Shape of the spikelet	Obovate	Ovate	Obovate	Ovate	Ovate with tapering tip	Ovate	Ovate	Oblong to obovate	Ovate	Ovate
Lemma	Awned	Awnless	Awnless	Awned						
Grain Colour	Brownish	Brownish	White	Yellowish	Awned	Awned	Awned	Awnless	Awnless	Awned
Percentage of pollen stainability	96—98	85—90	98—99	90—94	White 93—95	Brown 80—85	Brown 85—90	White 0	Brown 65—70	Brown 90—59

of meiotic studies on the hybrids have been confined to the determination of chromosome number and chromosome associations at diakinesis and MI. Thus a critical analysis of the synaptic behaviour of chromosomes at pachytene in the hybrids, a method to reveal the chromosomal differences between the species had been neglected. Because of availability of suitable techniques standardized by us, such studies are now possible which can prove to be very informative. The chromosomes at mid-pachytene stage may show a greater number of morphological landmarks which can aid in the identification of each individual chromosomes (MAGOON and SHAMBULINGAPPA, 1960). Further, even if the homologous chromosomes are closely paired, the presence of small structural differences, if any, in one of them will be clearly brought out at mid-pachytene only. Hence, an analysis of pairing at pachytene and chiasma formation at later stages undoubtedly lends a precision to the data on these phenomenon scored at MI. A detailed karyomorphological investigation of species and species hybrids is being undertaken with a view to have a better understanding of the taxonomy, genetics and phylogenetic evolution of the grain *Sorghum*. The present paper presents an account of cytomorphological behaviour of some species and species hybrids not reported earlier.

Material and methods

The following species and species hybrids were used in the present study:

1. *S. vulgare* (I.C. 1517)
2. *S. nervosum* (I.S. 3105)
3. *S. melaleucum* (P.I. 208708)
4. *S. sudanense* (P.I. 226009)
5. *S. arundinaceum* (P.I. 208573)
6. "M.S. Kafir" (Male sterile) (1601-A)
7. *S. nervosum* × *S. vulgare*
8. *S. vulgare* × *S. nervosum*
9. *S. melaleucum* × *S. nervosum*
10. *S. nervosum* × *S. melaleucum*
11. *S. nervosum* × *S. sudanense*
12. "M.S. Kafir" × *S. arundinaceum.*

Seeds of the parent species were obtained through the Rockefeller Foundation, Botany Division, Indian Agricultural Research Institute, New Delhi. All the crosses were effected under controlled conditions. The hybrids along with the parental plants were grown in the field and also in pots in the greenhouse. Plants grown in the field as well as those grown in the greenhouse were used for the study of morphology, pollen and meiosis of hybrids and parents. For meiotic studies the propiono carmine smears (SWAMINATHAN et al., 1954 and MAGOON et al., 1958) were used.

Observations

The morphological characters of both the parents as well as the hybrids are presented in Table 1 (Figs. 1—4). With regard to metrical characters such as plant height, leaf length, leaf breadth etc. some of the hybrids were intermediate but heterotic vigour was also manifest in the case of some other hybrids. The spikelets in *S. nervosum* possess red tinged tips as well as prominent nerves on the outer glumes. It may be noted that in all the F_1 hybrids involving *S. nervosum* as one of the parents, red tinged tip was

Table 2. *Showing the chiasma frequency in parents and hybrids.*

Species and Hybrids	Stage	No. of cells analysed	Bivalents with 1xma	Bivalents with 2xta	Total No. of chiasmata	Average No. of chiasmata per cell
S. nervosum	Diakinesis	50	478	22	978	19.56
	Metaphase I	50	316	184	816	16.32
S. melaleucum	Diakinesis	50	471	29	971	19.38
	Metaphase I	50	317	183	817	16.35
S. vulgare	Diakinesis	50	461	39	961	19.22
	Metaphase I	50	320	180	820	16.40
S. sudanense	Diakinesis	50	465	35	965	19.30
	Metaphase I	50	312	188	812	16.24
S. arundinaceum	Diakinesis	50	448	52	948	18.96
	Metaphase I	50	301	199	801	16.02
S. M. S. Kafir	Diakinesis	50	461	39	961	19.22
	Metaphase I	50	294	206	796	15.88
S. nervosum × *S. melaleucum*	Diakinesis	50	475	25	975	19.52
	Metaphase I	50	312	188	812	16.24
S. nervosum × *S. vulgare*	Diakinesis	50	455	45	955	19.12
	Metaphase I	50	293	207	793	15.86
S. nervosum × *S. sudanense*	Diakinesis	50	471	29	971	19.42
	Metaphase I	50	317	183	817	16.34
M. S. Kafir × *S. arundinaceum*	Diakinesis	50	449	51	949	18.98
	Metaphase I	50	308	192	808	16.16

always dominant over the colourless tips while prominent nerves on the outer glume was always a recessive character.

There were no differences in hybrids from *S. nervosum* × *S. vulgare* when crosses were made in both directions, the hybrid very predominantly of *vulgare* type of character. On the other hand, hybrids from the cross *S. nervosum* × *S. melaleucum* showed reciprocal differences. When *S. melaleucum* was used as the female parent, the hybrid matured earlier and the inflorescence resembled the female parent. On the contrary, when *S. nervosum* was used as the female parent, the hybrids matured a month later but they were taller than either of the parents. The inflorescence resembled the female parent. The true nature of hybridity of these F_1 individuals was confirmed by the dominant character of red tinged tip and lack of nerves on the outer glumes.

The other two hybrids, *S. nervosum* × *S. sudanense* and M.S. Kafir × *S. arundinaceum* resembled their respective male parents for most of their morphological characters.

Figs. 1—4. Ear heads of parents and hybrids (Left-Female, Middle-Hybrid, Right-Male).

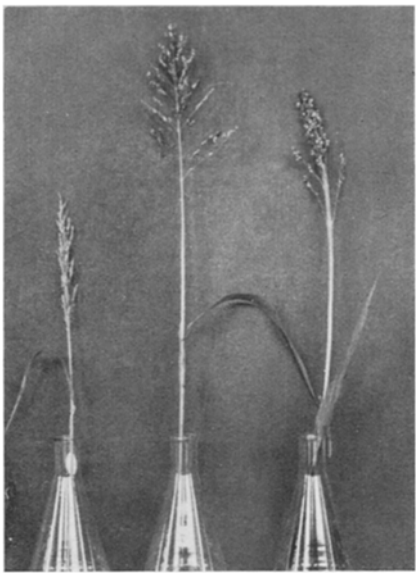


Fig. 1. *S. nervosum* × *S. vulgare.*

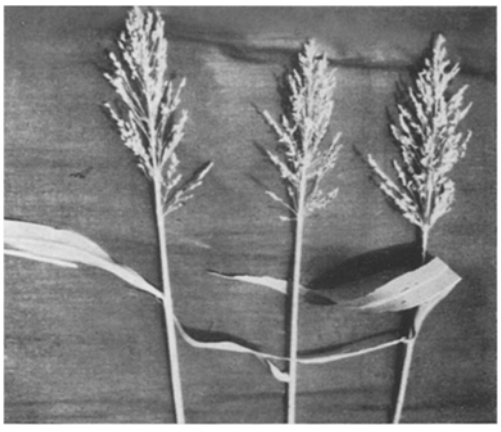


Fig. 3. *S. nervosum* × *S. sudanense.*

Fig. 2. *S. nervosum* × *S. melaleucum.*

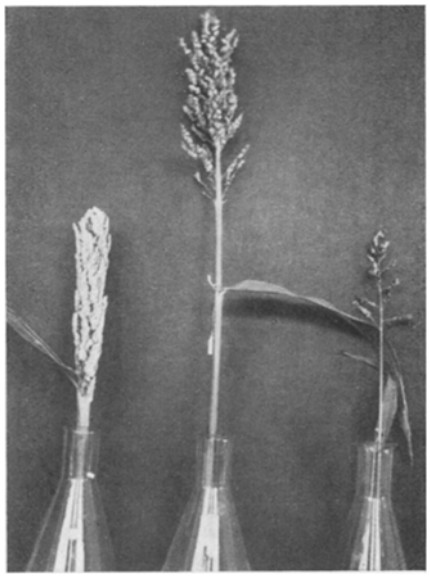


Fig. 4. M. S. Kafir × *S. arundinaceum.*

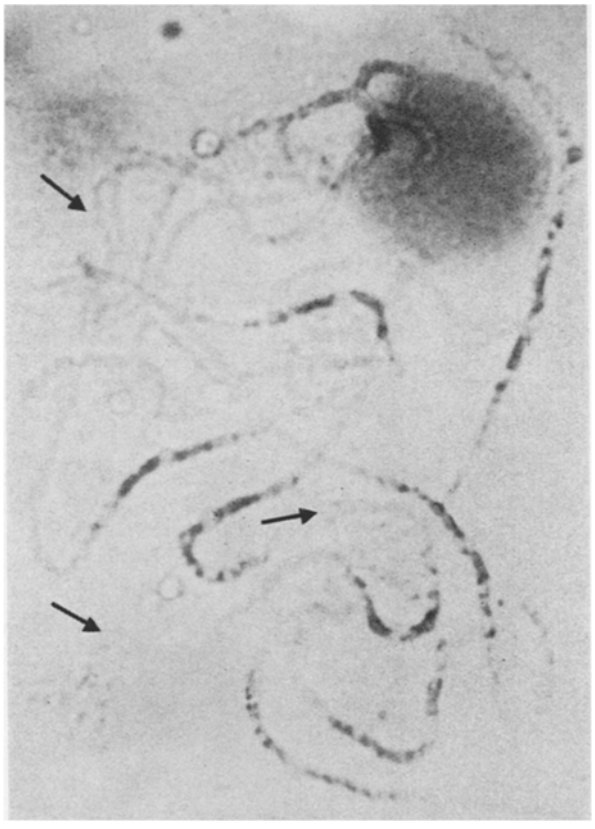
Meiosis in the species

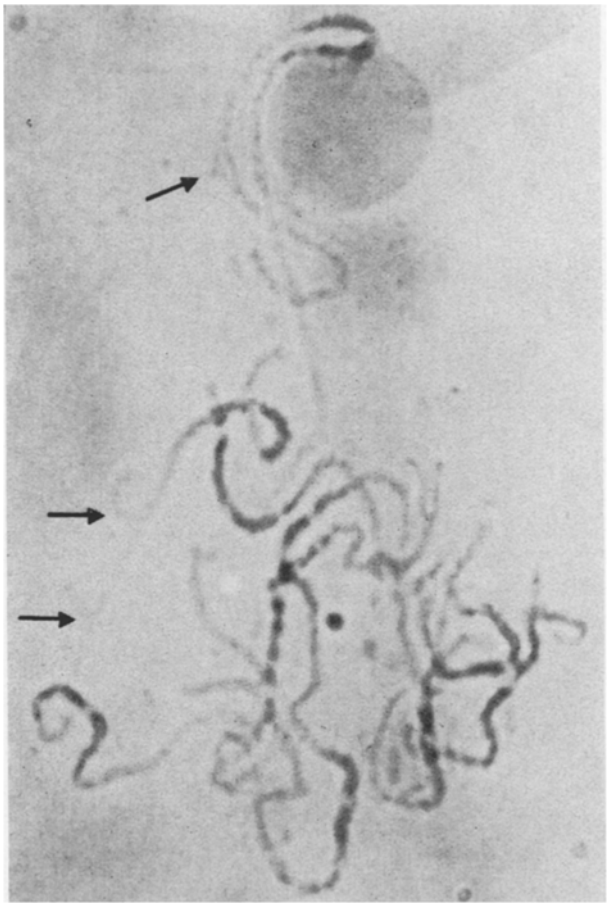
The chromosome associations and chiasma frequency both at diakinesis and MI were studied and are presented in Table 2. The synapsis of the homologous chromosomes at pachytene was found to be complete and normal in all the parental species. It was observed that the synapsis starts from the proximal to the distal end and separation of the split chromosomes starts from the distal to the proximal in all the species under study. Ten bivalents were found both at diakinesis and MI. Generally one bivalent was seen to be associated with the nucleolus at diakinesis. Occasionally in *S. nervosum*, *S. sudanense* and *S. arundinaceum*, one or two bivalents showed precocious separation at MI and the separated univalents lay opposite each other at the equatorial plate. The later meiotic stages were normal, followed by high percentage of stainable pollen except in the male sterile "Kafir" and good seed set in all the parental species.

Meiosis in species hybrids

The nature of synapsis of homologous chromosomes was studied in all the hybrids. It was noted that the initiation of pairing of these homologous chromosomes and then their separation were similar to that observed in the parental species. However, in the hybrids, *S. nervosum* × *S. sudanense* and M.S. Kafir × *S. arundinaceum*, observations on the synapsis of the

chromosomes at pachytene showed deviations from normal meiosis recorded in the parental species. In the former hybrid, one bivalent exhibited interstitial non-pairing region which was quite large. The same bivalent also showed a terminal non-pairing region and appeared to have a small deletion (Fig. 5). In addition to this one more bivalent exhibited terminal non-pairing region in both the arms. Apart from these, no other abnormalities in the pairing of homologous chromosomes could be noticed in this hybrid. In the later hybrid, the nucleolar chromosome exhibited interstitial non-pairing region indicating the presence of structural hybridity (Fig. 6). In addition, two more bivalents also showed terminal non-pairing regions and thus suggesting the probable existence of structural hybridity in more than two bivalents in this hybrid. The later stages of meiosis in the two above mentioned hybrids were found to be normal, in spite of the existence of such cytologically detectable, though minute structural differences as mentioned above. Ten bivalents mostly ring shaped, were noted at diakinesis (Fig. 7). At metaphase I, however, 10_{II} with varying proportion of ring and rod types were also usually found (Fig. 8).





Figs. 5/6. Pachytene stages in the F_1's of *S. nervosum* × *S. sudanense* and M. S. Kafir × *S. arundinaceum*, showing non-pairing regions (→) (×2100).

As in the parental species, one or two bivalents occasionally had a tendency to show precocious separation at MI. Chiasma frequency was studied both at diakinesis and MI and the data are presented in Table II. Good pollen stainability and good seed setting were observed in these two hybrids.

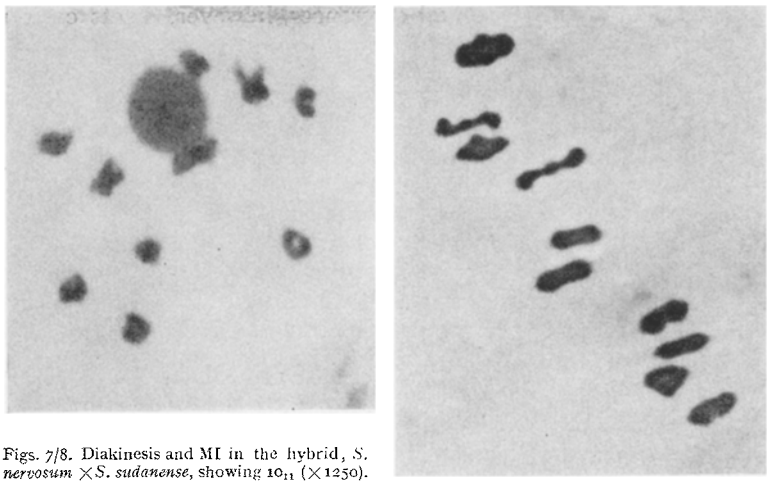
The analysis of pachytene pairing in the remaining four hybrids, *S. vulgare* × *S. nervosum* and its reciprocal and *S. melaleucum* × *S. nervosum* and its reciprocal, did not show any structural differences between the two chromosome sets. Pairing of pachytene chromosomes was complete (Figs. 9 & 10). 10_{II} were also normally found both at diakinesis and MI (Figs. 11 and 12). The analysis of chiasma frequency recorded at both these stages are given in Table II.

Anaphase I and later meiotic stages were normal with an equal distribution of 10 chromosomes to each of the tetrads. Good seed set and high percentage of pollen stainability were recorded in these hybrids. While normal dehiscence of anthers were found in all other hybrids, in the hybrid, *S. nervosum* × *S. melaleucum*, the anthers were of non-dehiscent type and the pollen could be only mechanically forced out by inserting the pointed end of a needle.

Discussion

The statement of Anderson (1955) that "the taxonomy of many of the world's important genera is so imperfect as to be of little practical use" is very apt for this genus of extensive variability. The delimitations of intra- and infra-specific categories in this genus lack the sharpness that a study of evolutionary interrelationships amongst the entities would require. There is a considerable controversy regarding the classification, both from the point of taxonomic treatment and of tracing phylogenetic interrelationships amongst the *Sorghum* species. Some workers suggest that all the cultivated *Sorghums* could be lumped into one species while several others tend to divide the material into series and species. The classification suggested by Snowden (1936) is admittedly

a classification for convenience in identifying "agricultural varieties" and even in this endeavour it failed since widely varying cultivars were included in one group, as for instance, the widely differing "Hegari" and "Black Kafir" being included into *S. caffrorum*. The available evidence, therefore, makes it highly unlikely that the thirty-one species listed by SNOWDEN (1936) are all genetically differentiated from one another, and consequently little biological reason to consider each as a distinct species. LAUBSCHER (1945) felt that all the species could not be regarded as varieties of *S. vulgare* but could not see the need for such an elaborate division of the material into six series and 31 species either. However, he proposed that the material be grouped into six races and felt the racial differences to be founded upon "modifier complex". Even if we agree with HARLAND (1939) that "modifier complex" do constitute the species differences, this concept does not seem to be appropriate for the *Eu-Sorghums* since inter-racial differences usually show a simple mendelian inheritance not normally expected out of differences based on "modifier complex".

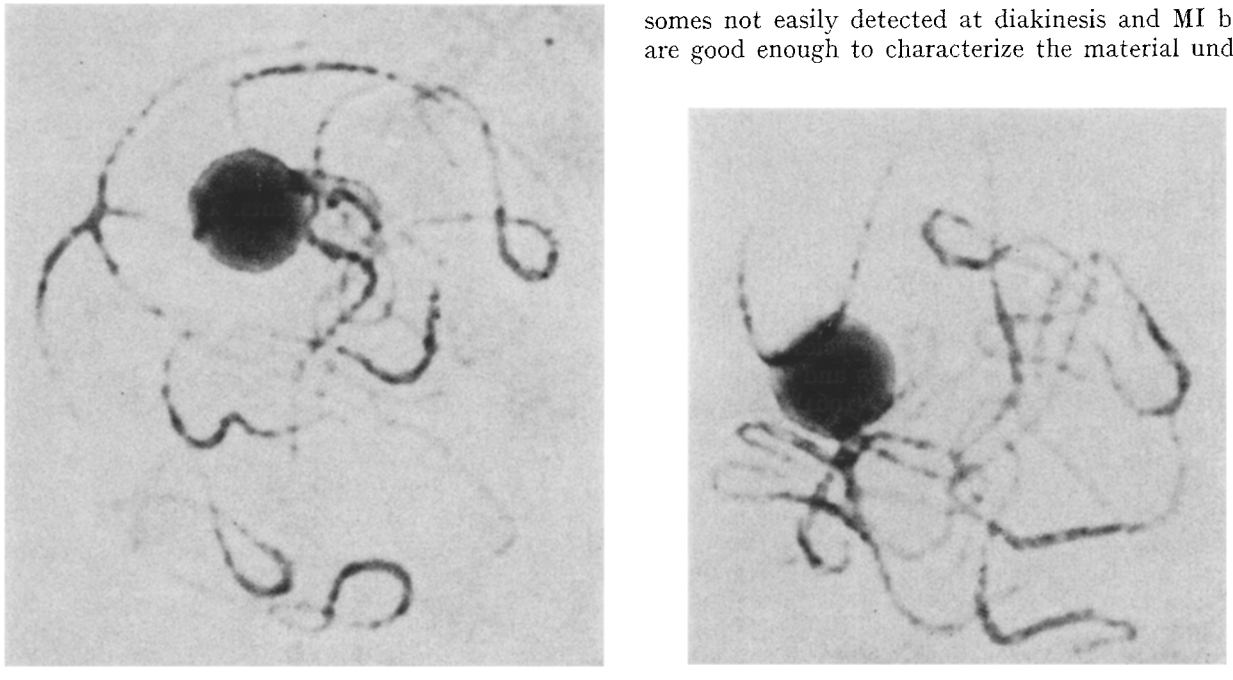


Figs. 7/8. Diakinesis and MI in the hybrid, *S. nervosum* × *S. sudanense*, showing 10_{II} (×1250).

Attempts of several investigators (see GARBER, 1950; DAURA and STEBBINS, 1952; HADLY, 1953 and ENDRIZZI, 1957) to derive chromosome homologies from the studies of chromosome pairing in hybrids, have not been fruitful, mainly due to the fact that their data on the pairing of chromosomes were studied at diakinesis and MI only. They reported complete homology between the chromosomes at least amongst the 20-chromosomed species. On the basis of their results it would be natural to expect a very free interchange of genes among these species. That this has not been so is obvious by the fact that some attempts to incorporate the desirable genes into one another have not been so far very rewarding thereby clearly indicating the limitations of this argument. It would be apparent from the foregoing account that no system of classification can be of universal acceptance until more cytogenetic information is presented.

MAGOON and RAMANNA (1961) have suggested that "inclusive herbaria" of the type envisaged for maize by ANDERSON (1955) would be extremely useful for *Eu-Sorghums*. In these, besides morphological characteristics, cytological features particularly the morphology of pachytene chromosomes are also included. A similar type of study in this group of plants is an immediate necessity because little headway can be made in the taxonomic treatment by the earlier studies which were limited only to the determination of chromosome numbers.

It becomes imperative therefore to look for tools that would render a finer resolution possible and the analysis of pachytene chromosome morphology would appear to be of immense value under the circumstances. It is now well recognized that such studies can reveal structural differences in the chromosomes not easily detected at diakinesis and MI but are good enough to characterize the material under



Figs. 9/10. Pachytene stages in the F_1's of *S. nervosum* × *S. vulgare* and *S. nervosum* × *S. melaleucum*, showing complete pairing (×1950).

consideration. Such structural differences, however, are manifest only in the study of pachytene stages in hybrids and hence it would need a thorough investigation of as many interspecific and interracial hybrids as possible. Further, to identify the genotype by means of structural differences has both a diagnostic as well as an applied significance. Chromosome associations at diakinesis and MI depend on both pairing and the formation of chiasmata at pachytene. Two related species may have chromosomes with certain amount of homologous regions which pair and permit chances for the formation of chiasmata which will undoubtedly lead to normal bivalent formation at diakinesis and MI. This will, therefore, mask the small structural differences, if any, between the chromosomes. When the structural change in the homologous chromosomes is large enough to prevent pairing and chiasma formation, only then the bivalent may fail to form. Hence, the study of diakinesis and MI alone, with regard to bivalent formation would possibly lead to inaccurate inferences.

The procedure of incorporating the desirable genes from the related wild flora into the commercial forms has various handicaps of hybrid sterility and viability. But when hybrids are not sterile and are fully viable it is at once assumed that a free interchange of genes between the two species is to be expected. That this has not been realized in practice is only too well known. Stebbins et al. (1946), considering the limitations for such a free interchange of genes, have taken recourse to the estimation of recombination index as an aid to the breeder. If the recombination index calculated on the basis of pairing and chiasma frequency at MI could be put to such use, data on pairing at pachytene stage could be all the more useful. From such a study, it should be possible to suggest to the breeder the cross combination he should concentrate his selection upon, an information which metaphase pairing in meiosis cannot provide and thus this would direct his efforts only into beneficial cross-combinations among the 20-chromosomed *Sorghums*.

Most of the earlier workers, on the basis of their observation of normal bivalent formation at diakinesis and MI concluded, that interspecific hybrids among the *Eu-Sorghums* are not qualitatively or quantitatively different from those in the corresponding parents. On the other hand, it is evident from the results obtained in the present as well as in the previous study of Magoon and Shambulingappa (1961) that this conclusion does not seem to be justified.

Sharma and Bhattacharjee (1957) reported marked differences in the idiograms of somatic chromosomes of a number of *Sorghum* species studied by them. On the other hand, Magoon and Shambulingappa (1961), and Magoon et al. (1961), from their study of the morphology of chromosomes at pachytene stage in a number of *Sorghum* species, demonstrated that the karyotype of the different species do not show much variation. They thus suggested that the species differentiation in the subsection *Arundinacea* of *Eu-Sorghums* is largely at the genic and cryptic structural level. It is now well recognized that structural differences between the chromosomes could conceivably co-exist with remarkably regular pairing if it is presumed that the chromosome sets concerned differ by a large number of cryptic structural differences and such differences may not be of much hindrance to pairing between chromosomes concerned and therefore meiosis would seem to be apparently normal. However, free exchange of genes located within or very close to such regions may be effectively prevented by them and thus lay the foundation for the species differentiation of the taxa concerned.

Sharma and Bhattacharjee (1957) have predicted on the basis of the marked karyotypic differences noted by them from their somatic chromosomes studies, highly irregular meiosis in the interspecific hybrids of the Subsection *Arundinacea* of *Eu-Sorghums*. On the contrary, observations of other workers did not reveal any such abnormality and rather found remarkably regular meiosis in the interspecific hybrids studied by them (Krishnaswamy et al. 1956, Endrizzi 1957; Kidd 1956 and Magoon and Shambulingappa 1961).

Pachytene analysis in the two hybrids (*S. nervosum* × *S. sudanense*; M. S. Kafir × *S. arundinaceum*) under study revealed the existence of some minute, though cytologically detectable, structural differences such as the presence of terminal and interstitial non-pairing segments, terminal deletion etc. These hybrids exhibited high percentage of stainable pollen and good seed setting inspite of these minute yet cytologically noticeable structural differences between the chromosomes. Magoon and Shambulingappa (1961) also reported the presence of such minute structural differences like the presence of duplication, differential terminal segments, nonpairing regions etc. in the two hybrids (M. S. Kafir × *S. verticilliflorum*; M. S. Kafir × *S. sudanense*) studied by them. Hence all these factors clearly point out that the existing chromosomal structural differences are quite small and do not lead to abnormal behaviour of the hybrids either in respect of morphological characters or in the meiotic process. Such differences, however, may be realized in the F_2 and later generations.

The remaining four hybrids under consideration, however, did not exhibit any structural differences between the chromosome sets. Synapsis of chromosomes was found to be complete as in the parents and followed by regular meiosis at later stages. Chiasma frequency also did not show any significant deviation from the parents. Good seed set and high percentage of stainable pollen were recorded.

A knowledge of the internal mechanisms responsible for the speciation in this group of plants is of great importance from the practical point of view also, because the breeder has to resort to interspecific crossing if he is to successfully incorporate some desirable genes into the cultivated varieties. Hence it becomes necessary that as much information should be obtained regarding the different taxa included in this extremely variable and complex genus as possible. Considering the cytogenetical mechanisms which may underlie the speciation in this genus, it is apparent that one such mechanism is the prevalence of a high degree of polyploidy ranging from $n = 5$ to $n = 30$. Although a considerable more genetic information is urgently needed to elucidate species differentiation in the genus *Sorghum*, it is evident from the prelimi-

nary data of some workers (see LAUBSCHER, 1945 and KIDD, 1956) that gene substitution of „modifier complex" have played a part. It also appears that the chromosome complements of many of these species differ by small structural changes which, however, do not lead to any cytologically visible irregularity — the so called „cryptic" structural difference (MAGOON et al. 1961). Evidence is also now available that minute, though cytologically detectable structural differences also do occur. Hence it would appear that both these types of structural differences seem to play an important role in speciation in this genus. The preliminary evidence of the reciprocal differences in the hybrid, *S. nervosum* × *S. melaleucum* suggests that cytoplasmic differences between some of these species may exist and might have played a role in species isolation. The role of gross structural changes, if any, however, still remains to be seen, as from the available data appears to be of relatively lesser importance.

Summary

1. The morphological characters of six species and six F_1 hybrids were compared in detail in the present study. It was observed that with respect to metrical characters the hybrids were intermediate in some cases but in certain others hybrid vigour was also met with.

2. Pachytene pairing was complete and apparently normal, followed by regular meiosis at later stages resulting in high pollen fertility and good seed setting in all the parental species except the male sterile „Kafir". Studies on the pairing properties of the differentially stained regions showed that synapsis starts from the proximal to the distal end and separation of the split chromosomes starts from the distal to the proximal.

3. Pachytene analysis in the hybrids, *S. nervosum* × *S. sudanense* and M. S. „Kafir" × *S. arundinaceum* revealed the presence of some minute, though cytologically detectable, structural differences such as terminal and interstitial nonpairing segments, terminal deletion etc. High percentage of fertile pollen and good seed setting were recorded in these hybrids. It is suggested that the existing chromosomal differences are quite small and do not lead to abnormal behaviour of the hybrids either in respect of morphological characters or in the meiotic process in the F_1 generation. Pachytene analysis in the remaining four F_1 hybrids was complete, followed by regular meiosis at later stages resulting in high percentage of stainable pollen and good seed set.

4. Cytogenetical mechanisms underlying species differentiation in the genus are discussed.

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Zusammenfassung

1. In der vorliegenden Arbeit wurden die morphologischen Eigenschaften von 6 Arten und 6 F_1-Bastarden verglichen. Dabei konnte beobachtet werden, daß sich die Bastarde in ihren meßbaren Eigenschaften in einigen Fällen intermediär verhielten, in bestimmten anderen traten jedoch Heterosiseffekte auf.

2. Der vollständigen und offensichtlich normalen Pachytänpaarung folgte eine reguläre Meiose, hohe Pollenfertilität und in allen Elternarten mit Ausnahme der männlich sterilen „Kafir" ein guter Samenansatz. Untersuchungen über das Paarungsvermögen differentiell gefärbter Abschnitte zeigten, daß die Synapsis von proximal nach dem distalen Ende zu fortschreitet und die Trennung der gespaltenen Chromosomen distal beginnt und sich nach proximal fortsetzt.

3. Die Pachytän-Analyse in den Bastarden *S. nervosum* × *S. sudanense* und M. S. „Kafir" × *S. arundinaceum* ergab das Vorhandensein einiger kleiner, jedoch cytologisch erkennbarer Strukturunterschiede, wie terminale und interstitielle nichtpaarende Abschnitte, terminale Deletionen usw. Ein hoher Prozentsatz von fertilen Pollen und guter Samenansatz wurde in diesen Bastarden festgestellt. Es wird angenommen, daß die bestehenden chromosomalen Unterschiede nur klein sind und nicht zu abnormalem Verhalten der Bastarde im Hinblick auf morphologische Eigenschaften oder den Meioseablauf in der F_1-Generation führen. Die Pachytän-Analyse in den übrigen 4 F_1-Bastarden ergab vollständige Paarung gefolgt von einer auch in den späteren Stadien regulären Meiose, hohem Prozentsatz färbbarer Pollen und gutem Samenansatz.

4. Die cytogenetischen Mechanismen, die der Artendifferenzierung in der Gattung zugrundeliegen, werden diskutiert.

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Aus dem Institut für Phytopathologie der Karl-Marx-Universität Leipzig

Untersuchungen zur physiologischen Spezialisierung von *Erysiphe graminis* DC.

I. Das Auftreten einiger Mehltaupopulationen auf verschiedenen Futtergräsern

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Mit 3 Abbildungen

A. Einleitung

Untersuchungen zur Frage der physiologischen Spezialisierung von *Erysiphe graminis* DC. wurden bisher in größerem Umfang in erster Linie mit dem Erreger des Getreidemehltaus durchgeführt. Besondere Berücksichtigung fanden dabei *Erysiphe graminis* f. sp. *tritici* auf Weizen und *Erysiphe graminis* f. sp. *hordei* auf Gerste (HOFFMANN und NOVER 1959, HONECKER 1937, 1938, MOSEMAN 1956, NOVER 1941, 1957, POWERS und SANDO 1960). Mit dem Mehltau der Futtergräser befaßten sich bisher nur wenige Autoren. Es konnte jedoch auch hier eine gewisse physiologische Spezialisierung beobachtet werden. So fand MARCHAL (1902, 1903), daß verschiedene „physiologische Varietäten", wie er es nannte, in ihrer Wirtswahl streng auf bestimmte Gramineengattungen begrenzt sind. Er nennt die Varietäten von *Triticum*, *Hordeum*, *Secale*, *Avena*, *Poa*, *Agropyron* und *Bromus*. SALMON (1905) unterteilte einige dieser Varietäten weiter in physiologische Rassen. In neuerer Zeit stellte HARDISON (1944, 1945) fest, daß die Angaben von MARCHAL teilweise nicht mehr zutreffen. Er untersuchte in seiner sehr umfangreichen Arbeit über 100 verschiedene Gramineenarten, die mit 8 Herkünften von *Erysiphe graminis* DC. infiziert wurden, und fand, daß fast alle der geprüften Mehltauherkünfte an verschiedenen Arten von zwei oder mehreren Gattungen Infektionen verursachen.

Da wir bei unseren laufenden Kontrollen der Futtergräserbestände immer wieder feststellen mußten, daß einzelne Grasarten sehr stark unter Mehltaubefall zu leiden haben, andere Grasarten dagegen kaum befallen werden, wurde das Problem der physiologischen Spezialisierung von *Erysiphe graminis* DC. im Hinblick auf die Futtergräser an unserem Institut erneut aufgegriffen. Es konnte dabei zunächst nicht unsere Aufgabe sein, Mehltaurassen in der Weise zu identifizieren, wie es beim Getreidemehltau üblich ist. Wir waren vielmehr darum bemüht, uns einen allgemeinen Überblick über das Verhalten unserer wichtigsten Futtergras-Arten und -Sorten gegenüber dem Echten Mehltau zu verschaffen.

B. Versuchsmaterial und Methodik

Als Infektionsmaterial verwendeten wir acht verschiedene Mehltaupopulationen, die von sieben verschiedenen Grasarten stammten, welche immer wieder besonders stark vom Echten Mehltau befallen worden waren. Es handelte sich dabei um *Dactylis glomerata* L., *Festuca pratensis* Huds., *Festuca heterophylla* Lam., *Festuca rubra* L., *Lolium perenne* L., *Poa pratensis* L. (2 Mehltauherkünfte) und *Trisetum flavescens* (L.) P.B. Um unerwünschte Fremd- oder Mischinfektionen auszuschließen, wurden die verschiedenen Mehltauherkünfte streng isoliert in getrennten Gewächshauskabinen vermehrt und in gewissen Zeitabständen immer wieder auf jüngere Pflanzen übertragen.

Mit diesen acht Mehltaupopulationen infizierten wir insgesamt 47 Sorten von 15 Nutzgräserarten, die während der Versuchsjahre von 1951 bis 1957 in der amtlichen Sortenliste der DDR aufgeführt waren. Die Anzucht der Gräser erfolgte in einem von den Kabinen getrennten Gewächshausraum. Die Infektionen der Gräser wurden im 3-Blattstadium mittels der Pinselinfektionsmethode (NOVER 1941) vorgenommen, wobei wir mit jeder der acht Mehltaupopulationen mindestens 100 Pflanzen infizierten. Zu diesem Zweck wurde mit einem Skalpell vorsichtig von mehltaukranken Blättern der Pilzbelag in ein Uhrschälchen mit Wasser abgestrichen und eine Konidiensuspension hergestellt. Mit einem feinen Haarpinsel verteilten wir diese Suspension auf die Blätter der zu infizierenden Pflanzen. Die weitere Aufstellung dieser Pflanzen erfolgte unter Glaszylindern, die mit feuchten Leinentüchern bedeckt waren. Acht Tage nach der Infektion wurde das erste Mal nach dem zu dieser Zeit üblichen Schema 1-5 bonitiert, wobei 1 vollkommene Befallsfreiheit und 5 den Tod der infizierten Pflanzen bedeuteten. Im Abstand von je drei Tagen folgten danach noch weitere 5 Bonitierungen. Von der letzten Bonitierung wurde für jede geprüfte Sorte ein Bonitierungsmittelwert (M) errechnet:

$$M = \frac{\Sigma \text{ aller Bonitierungswerte}}{\Sigma \text{ infizierte Pflanzen}}$$

Der Bonitierungsmittelwert der Kontrolle (Pflanzen der gleichen Sorte wie die Herkunftspflanzen der Mehltaupopulation) wurde gleich 100% gesetzt und die Bonitierungsmittelwerte der geprüften Sorten darauf bezogen und als Bi % bezeichnet. Der Befall einer Sorte über 100% besagt demzufolge, daß die betreffende Sorte stärker befallen wurde als die Herkunftssorte der geprüften Mehltaupopulation.