Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 323-327
Received: 11-11-2018
Accepted: 15-12-2018

Jitendra Nagpure
Research Scholar at Mycological Research Lab RDVV, Jabalpur, Madhya Pradesh, India

Pandey AK
Professor at Mycological Research Lab RDVV Jabalpur, Madhya Pradesh, India

Sajad Ahmad Mir
Research Scholars at Mycological Research Lab RDVV Jabalpur, Madhya Pradesh, India

Correspondence
Jitendra Nagpure
Research Scholar at Mycological Research Lab RDVV, Jabalpur, Madhya Pradesh, India

Diversity of VAM fungi associated with the roots of weed plants collected from different sites of Jabalpur Madhya Pradesh

Jitendra Nagpure, Pandey AK and Sajad Ahmad Mir

Abstract
In the present study total of thirty VAM fungal species belonging to 4 genera was recovered from roots and rhizosphere soil of selected weed plants. The result of the present investigation revealed that all the 10 weed *viz*. *Parthenium hysterophorus* L, *Sida acuta* Burm, *Euphorbia hirta* L., *Lantana camara* L., *Achyranthes aspera* L., *Datura metel* L., *Leonitis nepetaefolia* L., *Ludwigia parviflora, Malva parviflora, Solanum torvum,* belongs to different families were collected from in and around Jabalpur division of Madhya Pradesh, India and were investigated for the VAM fungi association. There was six genera of fungi belonging to Endogonaceae which have been shown to form mycorrhizal associations: *Glomus, Gigaspora, Acaulospora, Entrophospora Sclerocystis* and *Scutellospora*.

Keywords: VAM fungi, weed plants. *Parthenium hysterophorus* L.

Introduction
The limited biological diversity characteristic of current high-input 'industrialized' farms is an important cause of many problematic aspects of these agro-ecosystems (Altieri, 1999) [6], such as high losses of nutrients and soil, and dependence on pesticide and fertility inputs (Matson *et al*., 1997) [23]. Consequently, restoration of biodiversity is an important strategy for mitigating these problems (Altieri, 2002) [7]. The plant component of agro-ecosystem biodiversity includes crops and weeds. The fungal wealth below the ground is soil fungi or the fungi in soil. Soil being a complex ecosystem, it harbours the fungi belonging to all the major taxonomic groups, out numbering the other microbes and in their biomass also (Anderson & Domsch, 1978; Kjoller & Struwe, 1982) [8, 22].
Taxonomy of any group of plants is an important aspect for a botanist (Burdsall, 1990) [13]. Ecology of VAM mycorrhizal associations, inoculum production and its application in the field and an analysis of results have been discussed in views by Mosse (1981) [24]; Abbott (1982) [1]; Barea and Azcon-Aguilar (1983) [9]; and Safir (1987) [26]. However, evidence is mounting that individual species differs significantly in their effectiveness to promote growth in changes in soil fertility (Abbott and Robson, 1978) [2], Soil pH (Hayman and Tavares, 1985) [19] and drought (Allen and Boosalis, 1983) [5]. Eco-types of VAM have been identified which are adapted to soil containing high concentration of heavy metals (Gildon and Tinker, 1983) [17], Aluminum (Adelman and Morton, 1986) [3] and Salt (Allen and Cunnigham, 1983) [4]. Differences in growth response of crop plant by different strains of VAM fungi have been also reported (Hass and Krikun, 1985) [18].
The role of VAM in reducing the harmful effect of root infestation by many parasitic nematodes in crop plants is now well recognized (Hussey and Rancadori, 1982; Jalali and Chand, 1990) [20, 21]. Dalpe (1997) [14] reported advantages and benefits of adopting VA-mycorrhizae in agriculture *viz*. Improvement plant nutrition, tolerance to water stress, resistance to low temperature. More number of VAM spores was found in cultivated soils than the non-cultivated soils (Mukerji and Kapoor, 1990) [25]. Gerdemann and Bakshi (1976) [15] reported for the first time two new species *viz*. *Glomus multicaule* and S*clerocystis sinousa.* Battacharjee and Mukerji (1980) [10] reported *Glomus caledonium, G. fulvus, G. invermanium and G. microcarpum* from different regions of India. They have also reported a few new records from India *viz. Sclerocystis dussii, S. rubiformis, Gigaspora corrolloidea* and *Modicella reniformis.* Battacharjee *et al*., (1982) [11] described the ultrastructure of *Sclerocystis coremioides* and also reported two new species i.e. *Glomus multisubtensum* and *G. delhiense.*

Materials and Methods
Collection of soil and root samples
A total of 20 weed plants were collected from two sites from each district of Jabalpur division.

The roots of these plants were separated from the soil, washed and stored in lactophenol for determining root colonization.

Enumeration of VAM spore population

The spores of mycorrhizal fungi were separated from rhizosphere soil by wet sieving and decanting method as detailed by Gerdemann and Nicolson (1963) [16]. The soil particles and spores collected in 45 µm sieves were taken in 100 ml conical flasks separately. The suspension in each flask was shaken thoroughly and allowed to settle for 30 seconds. The spores present in these suspensions were trapped on a nylon mesh with 45 µm pore size placed on a marked petridish and the number of spores was counted by observing under a stereo-microscope (Olympus OIC 1629). Shriveled and desiccated spores were omitted.

Identification of spores

Spores of common genera of VAM were identified by observing diagnostic characteristics such as spore wall, color, size and type of hyphal attachment according to Schenck and Prez (1990).

Assessment of root colonization

The surface feeder roots were cut into 1 cm bits washed and heated to about 90°C for 1 h in 10 per cent potassium hydroxide solution in a water bath, subsequently washed in distilled water and immersed in alkaline 3 percent hydrogen peroxide for 5 min. It was rinsed four times in distilled water and acidified by immersing for five minutes in 2 per cent hydrochloric acid. The acid was poured off and root segments were stained with 0.05 per cent trepan blue in lactophenol for 20 minutes. The stain was poured off and added with lactophenol and kept overnight to destain the host and tissues. Root segments were mounted on glass slide with lactophenol and examined under a microscope for mycorrhizal infection. Mycorrhizal colonisation was expressed using the following formula:

$$\text{Percent VAM colonization} = \frac{\text{Number of root segments with VAM}}{\text{Total number of root segments examined}} \times 100$$

Estimation of VAM fungi

The term frequency was used to assess the establishment and survivability of VAM fungi in the rhizosphere of the host. Frequency denotes the number of samplings in which spores of a particular VAM fungus present during the study period and expressed as percentage using the following formula:

$$\text{VAM frequency (\%)} = \frac{\text{Number of sampling in which a particular VAM was recorded}}{\text{Total number of sampling}} \times 100$$

$$\text{VAM occurrence (\%)} = \frac{\text{Total number of VAM spores of individual weed plant}}{\text{Total number of VAM spores of all weed plant}} \times 100$$

Table 1: Natural occurrence of VAM spores in studied weed plants of Jabalpur region

S. N	VAM Fungi	1	2	3	4	5	6	7	8	9	10
1.	*Acaulospora sp*	+	+	+	-	+	-	+	-	+	+
2.	*Aculospora appendiculata*	+	-	+	-	-	+	-	+	-	-
3.	*Aculospora foveata*	+	+	+	-	-	-	+	+	+	+
4.	*Aculospora rehmii*	+	+	+	-	-	-	-	-	-	-
5.	*Aculospora scrobiculata*	-	+	+	+	-	+	+	-	+	+
6.	*Aculospora spinosa*	+	+	-	-	-	-	+	-	-	-
7.	*Aculospora delicata*	+	-	-	-	-	-	-	-	-	-
8.	*Glomus mosseae*	+	+	+	+	+	+	+	+	+	+
9.	*Glomus fasciculatum*	+	+	+	+	+	+	+	+	+	+
10.	*Glomus aggregatum*	+	+	+	+	+	+	+	-	+	+
11.	*Glomus geosporum*	+	+	+	-	+	+	-	+	+	+
12.	*Glomus intraradices*	+	+	+	+	+	+	+	+	-	+
13.	*Glomus macrocarpum*	+	+	+	-	+	+	+	+	+	-
14.	*Glomus monosporum*	+	+	-	-	-	+	+	+	+	+
15.	*Glomus etunicatum*	+	+	-	+	+	-	+	+	+	+
16.	*Glomus reticulatum*	+	+	-	-	-	-	-	-	-	-
17.	*Glomus albidum*	+	+	+	+	+	+	+	+	+	+
18.	*Glomus invermatium*	+	+	+	+	+	+	+	+	+	+
19.	*Glomus taiwanense*	+	+	-	+	+	+	-	-	+	+
20.	*Glomus pachycaule*	+	-	+	+	+	+	+	+	-	-
21.	*Glomus pubescens*	+	+	+	-	+	-	+	+	-	+
22.	*Glomus sinuosum*	+	+	-	-	+	+	+	+	+	+
23.	*Sclerocystis sp*	+	+	-	-	-	-	-	-	-	-
24.	*Sclerocystis coremoides*	+	+	-	+	-	-	+	+	+	-
25.	*Sclerocystis microcarpus*	+	+	+	+	-	-	-	+	-	+
26.	*Sclerocystis clavispora*	+	+	-	-	-	-	-	-	+	+
27.	*Sclerocystis sinuosa*	+	+	-	-	-	-	-	-	-	-
28.	*Gigaspora margarita*	+	+	-	-	-	-	-	-	-	-
29.	*Gigaspora rosea*	+	-	-	-	-	-	-	-	-	-
30.	*Gigaspora gigantea*	+	-	-	-	-	-	-	-	+	+

1. *Parthenium hysterophorus* L 2. *Sida acuta* Burm 3. *Euphorbia hirta* L. 4. *Lantana camara* L. 5. *Achyranthes aspera* L. 6. *Datura metel* L. 7. *Leonitis nepetaefolia* L. 8. *Ludwigia parviflora* 9. *Malva parviflora* 10. *Solanum torvum*

Table 2: Spore density of VAM fungi in rhizospheric soil of studied weed plants of Jabalpur region

S. No.	Weed	Spore density	
		Spore count/100g soil	% Occurrence
1.	*Parthenium hysterophorus* L	435	9.60
2.	*Sida acuta* Burm	421	9.29
3.	*Euphorbia hirta* L.	165	3.64
4.	*Lantana camara* L.	15	0.33
5.	*Achyranthes aspera* L.	362	7.99
6.	*Datura metel* L.	132	2.91
7.	*Leonitis nepetaefolia* L.	357	7.88
8.	*Ludwigia parviflora*	182	4.02
9.	*Malva parviflora*	295	6.51
10.	*Solanum torvum*	197	4.35

Table 3: Comparison of chemical properties in and around the soil of studied weed plants of Jabalpur region

S. No	Plant Name	pH	EC (mS/s)	Org. Carbon (%)	Available Nitrogen (Kg/Ha)	Available Phosphorus (Kg/Ha)	Available Potassium (Kg/Ha)
1	*Parthenium hysterophorus* L	6.67	0.183	0.30	143	7.5	85
2	*Sida acuta* Burm	6.52	0.122	0.52	208	10.2	103
3	*Euphorbia hirta* L.	6.61	0.148	0.40	180	8.2	94
4	*Lantana camara* L.	6.93	0.212	0.34	162	7.5	85
5	*Achyranthes aspera* L.	6.85	0.153	0.57	223	11.6	111
6	*Datura metel* L.	6.79	0.248	0.37	167	10.2	94
7	*Leonitis nepetaefolia* L.	6.81	0.219	0.73	274	12.3	129
8	*Ludwigia parviflora*	6.87	0.180	0.79	277	12.3	129
9	*Malva parviflora*	6.77	0.189	0.38	171	10.9	103
10	*Solanum torvum*	6.55	0.171	0.42	189	10.9	111

Microscopic pictures of VAM spores

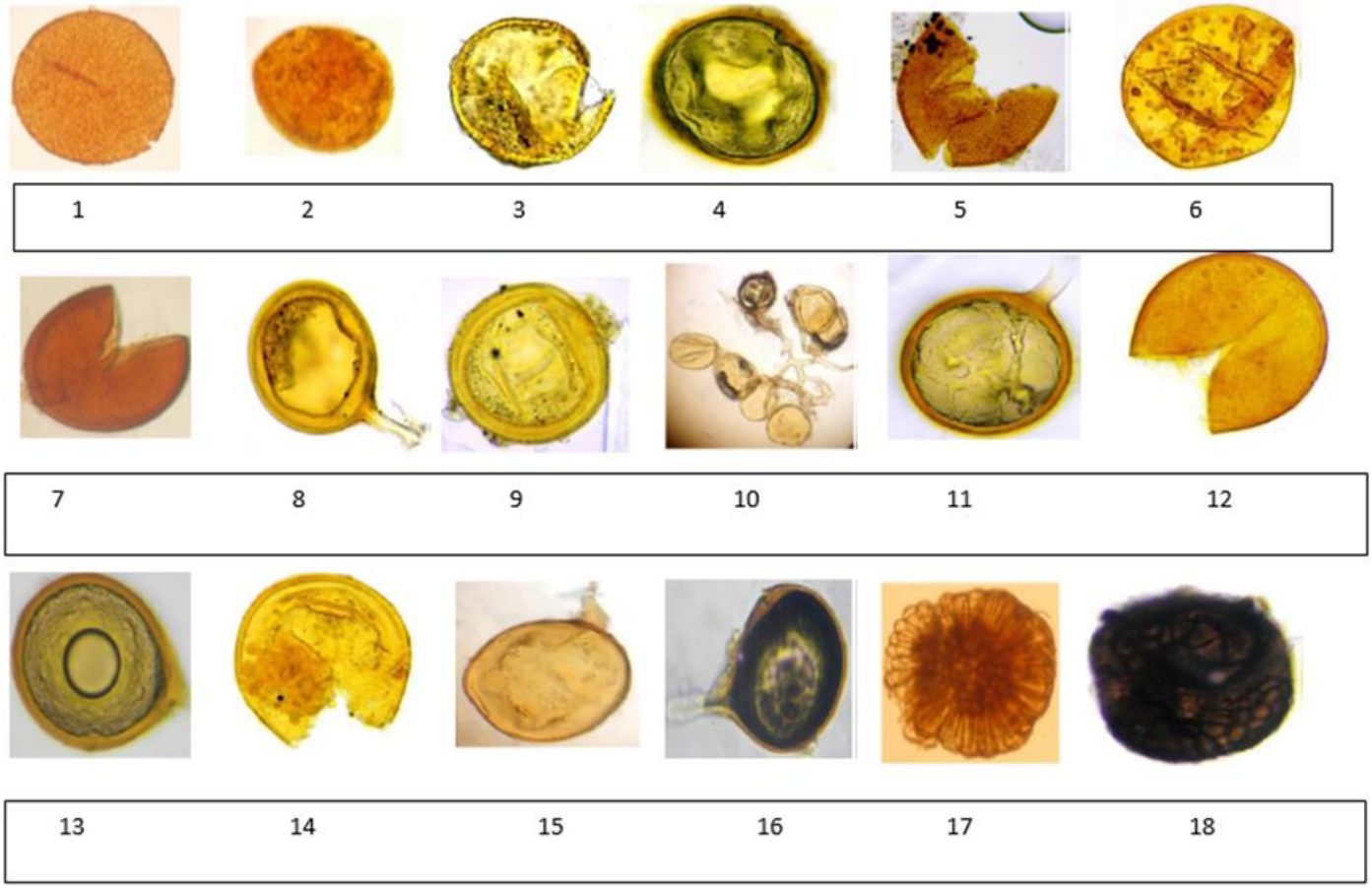

Fig 1: 1. *Acalauspora spp*., 2. *Acaulospora apendiculata*, 3. *Acaulospora foveata*, 4. *Acaulospora rehmii*, 5. *Acaulospora scorbiculata*, 6. *Acaulospora spinosa*, 7. *Acaulospora delicate*, 8. *Glomus mosseae*. 9. *Glomus fasciculatum*, 10.*Glomus aggregatum*, 11.*Glomus geosporum*, 12.*Glomus intraradices*, 13. *Glomus macrocarpum* 14. *Glomus monosporum*, 15. *Glomus etunicatum*, 16. *Glomus invermatium*, 17. *Glomus taiwanense*, 18. *Glomus pachucaule*,

Microscopic visualization of VAM fungi on roots of some weeds

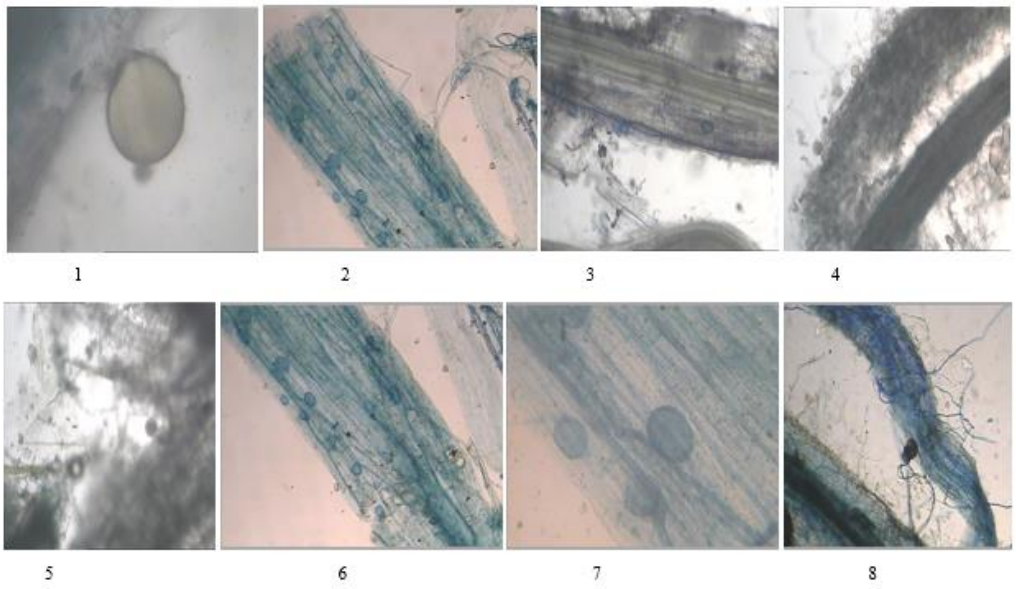

Fig 2: 1. *Parthenium hysterophorus* L. 2. *Sida acuta* 3.*Euphorbia hirta* 4. *Lantana camara* 5. *Achranthes aspera* 6. *Datura metel* 7. *Leonitis nepetaefolia* 8. *Ludwigia parviflora*

Discussions

The present study revealed the natural presence of VA mycorrhiza in all of the 10 weed plants. Variations were observed in the species composition of Arbuscular mycorrhizal fungal organisms present in the rhizosphere of all the weed plants studied. Fungal organisms present in the rhizosphere of the individual plant species were also varied; though were found common to all the plants. A total 30 VAM species were identified from 10 weed plants species. However, there is significant difference in the rate of Arbuscular mycorrhizal infection. The fungal infection was maximum on *Parthenium hysterophorus* L.

During the study significant variation in spore population inhabitating rhizospheric soil of the test weed were recorded. Spores of *Glomus mosseae* and *Acaulospora sp*. were observed in all the studied weed plants while *Gigaspora* produces spores only in 4 weed plants. The differences in presence of spore and their numbers obtained may be due to variations in host weed root type and morphology, carbon biomass or nutrient and endogenous hormonal levels (Brundrett *et al*., 1999) [12].

Glomus mosseae and *Acaulospora sp* are the dominant species in the rhizosphere of all the studied weeds. Though genus Glomus has been reported to be the predominant flora in many plant species

Conclusion

Total number of mycorrhizal spores and the diversity of arbuscular mycorrhizal fungi showed variation among the rhizosphere of selected weed plants. Looking to the incidence of VAM associated with the weed, it can be exploited for mass multiplication each of the VAM fungi. However detailed investigation need to be carried out before recommendation.

Acknowledgement

I would like to acknowledge HOD department of biological sciences my supervisor Prof. A.K. Pandey and my senior research scholar Dr. Sajad Ahmad Mir for their kind support and sympathy to my research work.

References

1. Abbott LK. Comparative anatomy of vesicular-arbuscular mycorrhizas formed on subterranean clover. Australian Journal of Botany. 1982; 30(5):485-499.
2. Abbott LK, Robson AD. Growth of subterranean clover in relation to the formation of endomycorrhizas by introduced and indigenous fungi in a field soil. New phytologist. 1978; 81(3):575-585.
3. Adelman MJ, Morton JB. Infectivity of vesicular-arbuscular mycorrhizal fungi, influence of host-soil diluent combinations on MPN estimates and percentage colonization. Soil Biology and Biochemistry. 1986; 18(1):77-83.
4. Allen MH, Cunningham GL. Effects of vesicular–arbuscular mycorrhizae on Distichlis spicata under three salinity levels. New Phytologist. 1983; 93(2):227-236.
5. Allen MF, Boosalis MG. Effects of two species of VA mycorrhizal fungi on drought tolerance of winter wheat. New Phytologist, 1983; 93(1):67-76.
6. Altieri MA. The ecological role of biodiversity in agro ecosystems. In Invertebrate Biodiversity as Bioindicators of Sustainable Landscapes, 1999, 19-31.
7. Altieri MA. Agroecological principles for sustainable agriculture In Uphoff, N.(ed.). Agroecological Innovations. Increasing Food Production with Participatory Development. Earthscan, London, UK, ISBN, 1-85383-857-8, 2002, 306.
8. Anderson JPE, Domsch KH. A physiological method for the quantitative measurement of microbial biomass in soils. Soil biology and biochemistry. 1978; 10(3):215-221.
9. Barea JM, Azcon-Aguilar C. Mycorrhizas and their significance in nodulating nitrogen-fixing plants. In *Advances in agronomy*. Academic Press. 1983; 36:1-54.
10. Bhattacharjee M, Mukerji KG. Studies on Indian Endogonaceae. II. The genus Glomus. *Sydowia*, 1980; 33:14-17.
11. Bhattacharjee M, Mukerji KG, Tewari JP, Skoropad WP. Structure and hyper parasitism of a new species of Gigaspora. Transactions of the British Mycological Society. 1982; 78(1):184-188.

12. Brundrett M, Kendrick B. The roots and mycorrhizas of herbaceous woodland plants. New Phytologist. 1990; 114(3):457-468.
13. Burdsall HH. Taxonomic mycology, concerns about the present; optimism for the future. Mycologia, 1990; 82(1):1-8.
14. Dalpe Y. Report prepared from the Third meeting of the subsidiary body on scientific Technical and Technological Advice (SBSTTA) *Convention on Biodiversity* held at Montreal Quebec Canada on 5th, 1997.
15. Gerdemann JW, Bakshi BK. Endogonaceae of India, two new species. Transactions of the British Mycological Society. 1976; 66(2):340-343.
16. Gerdemann JW, Nicolson TH. Spores of mycorrhizal Endogone species extracted from soil by wet sieving and decanting. Transactions of the British Mycological society. 1963; 46(2):235-244.
17. Gildon AA, Tinker PB. Interactions of vesicular-arbuscular mycorrhizal infection and heavy metals in plants. New Phytologist. 1983; *95*(2):247-261.
18. Haas JH, Krikun J. Efficacy of endomycorrhizal-fungus isolates and inoculum quantities required for growth response. New Phytologist. 1985; 100(4):613-621.
19. Hayman DS, Tavares M. plant growth responses to vesicular-arbuscular mycorrhiza. New Phytologist. 1985; 100(3):367-377.
20. Hussey RS, Roncadori RW. Vesicular-Arbuscular Mycorrhizae May Limit Nemotode Activity ond Improve Plant Growth. Plant Disease. 1982; 66:9-14.
21. Jalali BL, Chand H. Current trends in mycorrhizal research, proceedings of the National Conference on Mycorrhiza. Hisar, 1990, 14-16.
22. Kjoller A, Struwe S. Microfungi in ecosystems, fungal occurrence and activity in litter and soil. Oikos. 1982, 391-422.
23. Matson PA, Parton WJ, Power AG, Swift MJ. Agricultural intensification and ecosystem properties. Science. 1997; 277(5325):504-509.
24. Mosse B. Vesicular-arbuscular mycorrhiza research for tropical agriculture, 1981.
25. Mukerji KG, Kapoor A. Taxonomy of VAM fungi with special reference to Indian taxa. Taxonomy of VAM fungi with special reference to Indian taxa. 1990, 7-16.
26. Safir GR. (Ed.). Ecophysiology of VA mycorrhizal plants. Boca Raton, CRC Press, 1987, 224.