



(33)

3209 0

Special Bulletin No. 2.

STATE OF ISRAEL  
MINISTRY OF AGRICULTURE  
AGRICULTURAL RESEARCH STATION, REHOVOT.

33

"GALINSOGA PARVIFLORA CAVAN"

A new weed-immigrant in Israel

by

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Rehovot, August 1956.

## STUDIES ON WEED ECOLOGY:

1. "Galinsoga parviflora Cavan., a new weed-immigrant in Israel"  
By Dr. Elisabeth Boyko.

### Introduction

In the course of our observation on weeds we happened to notice on March 6th 1956 a small and rather insignificant looking plant in a dense group which stood in one of the mixed flowerbeds in the Agricultural Research Station in Rehovot, Israel. In the following days I found it on several more sites inside the Station area although less abundant.

I recognised the plant as an old weed-acquaintance from Europe, which had aroused my interest there, because of its unusual background. No reference to any occurrence in S.W. Asia has been published up to now.

Description: As the plant has been described by their authors we may here forego a detailed description; in its place see figs. No. 1 and 2.

According to the morphological characteristics I identified the plant as a transition-form between *Galinsoga parviflora* Cavan. and *G. quadriradiata* R. et P. and we came to the conclusion that most probably both are only varieties of the same species. This is all the more possible as they both show the same ecological amplitude and a similar occurrence and often even the same history. We may put this suggestion to one of the specialists of this group of Compositae. A more decisive answer however has to be looked for by additional genetical studies. The Table 1. enumerates the difference between the two species *G. parviflora* and *G. quadriradiata* and explains why we look upon our plant as a transition-form between the two.

### History:

*Galinsoga parviflora* has spread from the warm and humid regions of Chile, Peru, Columbia, Venezuela through Central America (Mexico) to similar regions in the southern parts of N. America. (Hegi, 7).

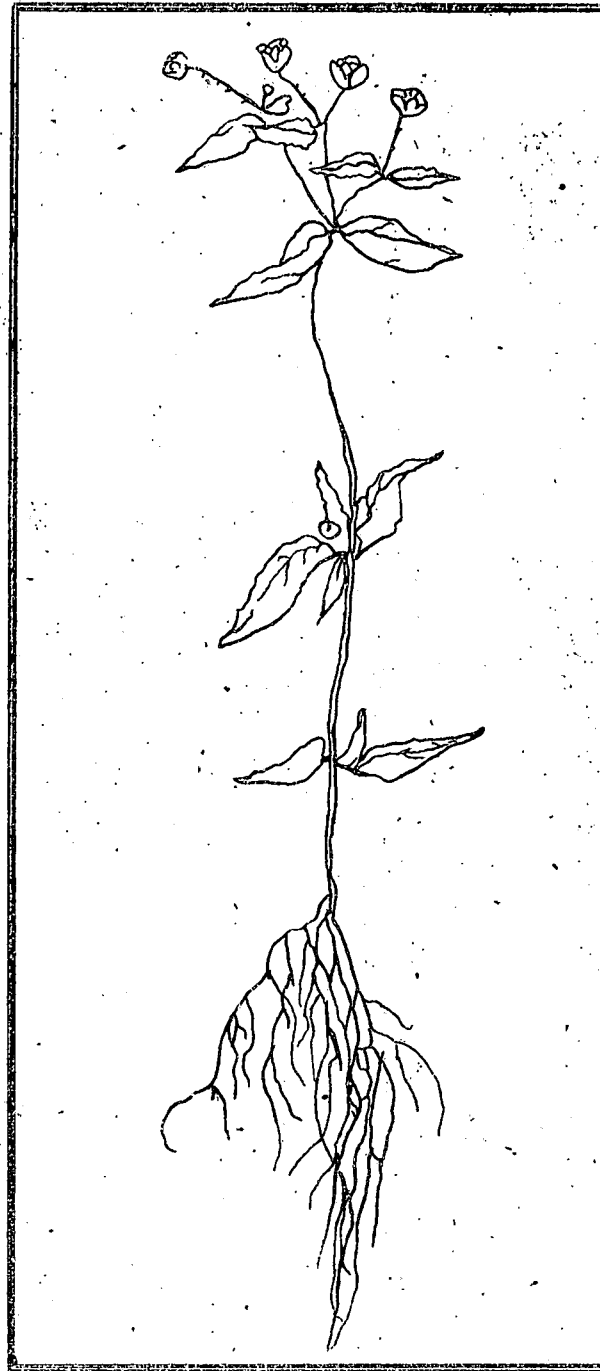


Fig 1: *Galinsoga parviflora* Cavan. from Rehovoth

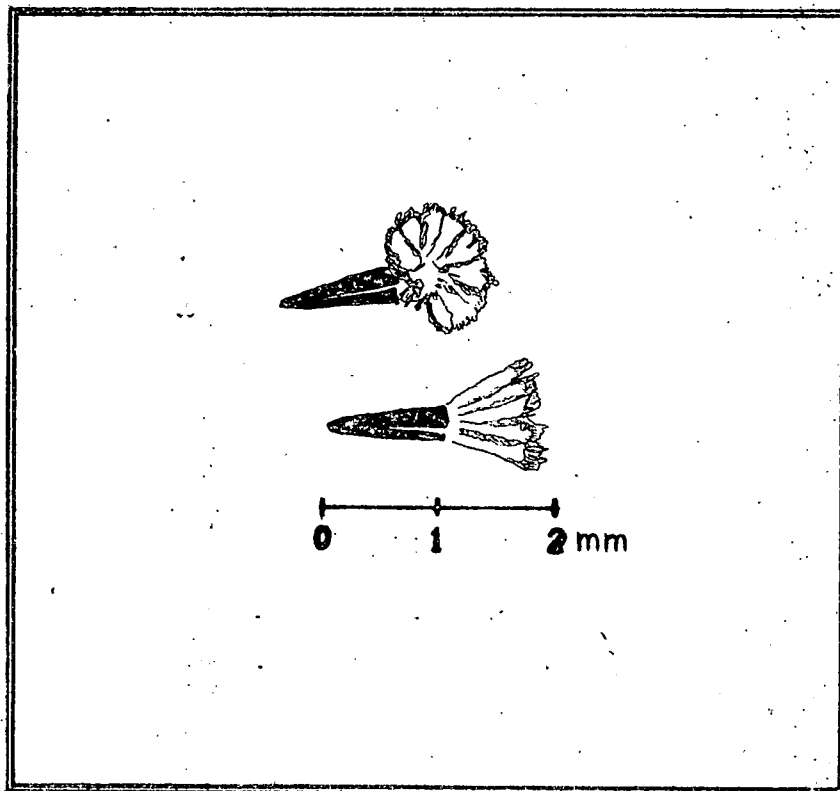


Fig 2: Seed of Galinsoga.

# TABLE I

Species - differences according to descriptions

Species	1) Stem	2) Peduncles	3) Scales of
<i>Galinsoga parviflora</i> Cavan	fairly glabrous below pubescent above	without glands or with few gland-tipped hairs	receptacle mostly trifid
<i>Galinsoga</i> from Rehovot	glabrous below pubescent above with single long hairs, some indivi- duals more pubesce- nt at the upper part of the stem, some individuals more pilose	densely beset with glands tipped hairs	from 50 acc- ounted for: 38 were tri- fid 64% 18 were tri- fid 36%
<i>Galinsoga quadriradiata</i> Re et Pe	long-haired pilose particularly on the upper part	with glands tipped hairs	mostly entire

In respect to the 3 differentiating properties 1), 2) and 3) between *Galinsoga parviflora* Cavan and *Galinsoga quadriradiata* Re et Pe, the *Galinsoga* from Rehovot shows:

- No. 1) (Stem) and intermediate position
- No. 2) (Peduncles) a close relationship to the characteristics of *Galinsoga quadriradiata*
- No. 3) (Scales of receptacle) a close relationship to the characteristics of *Galinsoga parviflora*

Its appearance as a fugitive from the Botanical Garden in 1812 had been noticed and its further progress throughout the moister and at least in summer warmer parts of Europe, could be followed. Its conquering march stopped upon reaching the meeting-area between the arid border-forest-belt and the steppe-region. In old Austria for instance this was in the Viennese basin, in Moravia and along the eastern border of the Eastern Alps. (1. Beck-Mannagetta). Its spreading in the European countries has been watched with great interest by botanists and with fear and anger by gardeners and agriculturists. According to Hegi (7) it was observed in Austria in 1820, as very rare still in Vienna in 1850 but as frequent already by 1864; then more and more frequently in various places in Austria, Moravia, and Germany. Simultaneously it found its way into the coffee-plantations of the East Indies into Australia since 1873 and New Zealand since 1904. Since then it has entered also other humid-tropical areas, mainly of tropical Africa (Cameroon). Madagascar, etc. penetrating into the coffee-plantations where it is said to be an indicator of good coffee-soils.

Its march of conquest is to be seen in the map (Fig. 3). (Following this spreading from its original home over the other continents) we believe that this spreading has occurred in one direction only, which has been marked in Fig. 3 (with arrow) for the following reasons: In almost all cases it was involuntarily introduced with commercial flowerseeds, originating probably either from Central Europe, from England, France or Holland.

The development of the commercial export of flowerseed from America to overseas is only a matter of the last few deceniums. The same applies to S. Africa as a place of seed-distribution to African countries. It seems probable that the seeds were imported together with flower seeds similar to its own (Fig. 2) in size, colour or shape, as e.g. Asters or with black seeds like Zinnias or Dianthus and mistaken for broken particles of these.

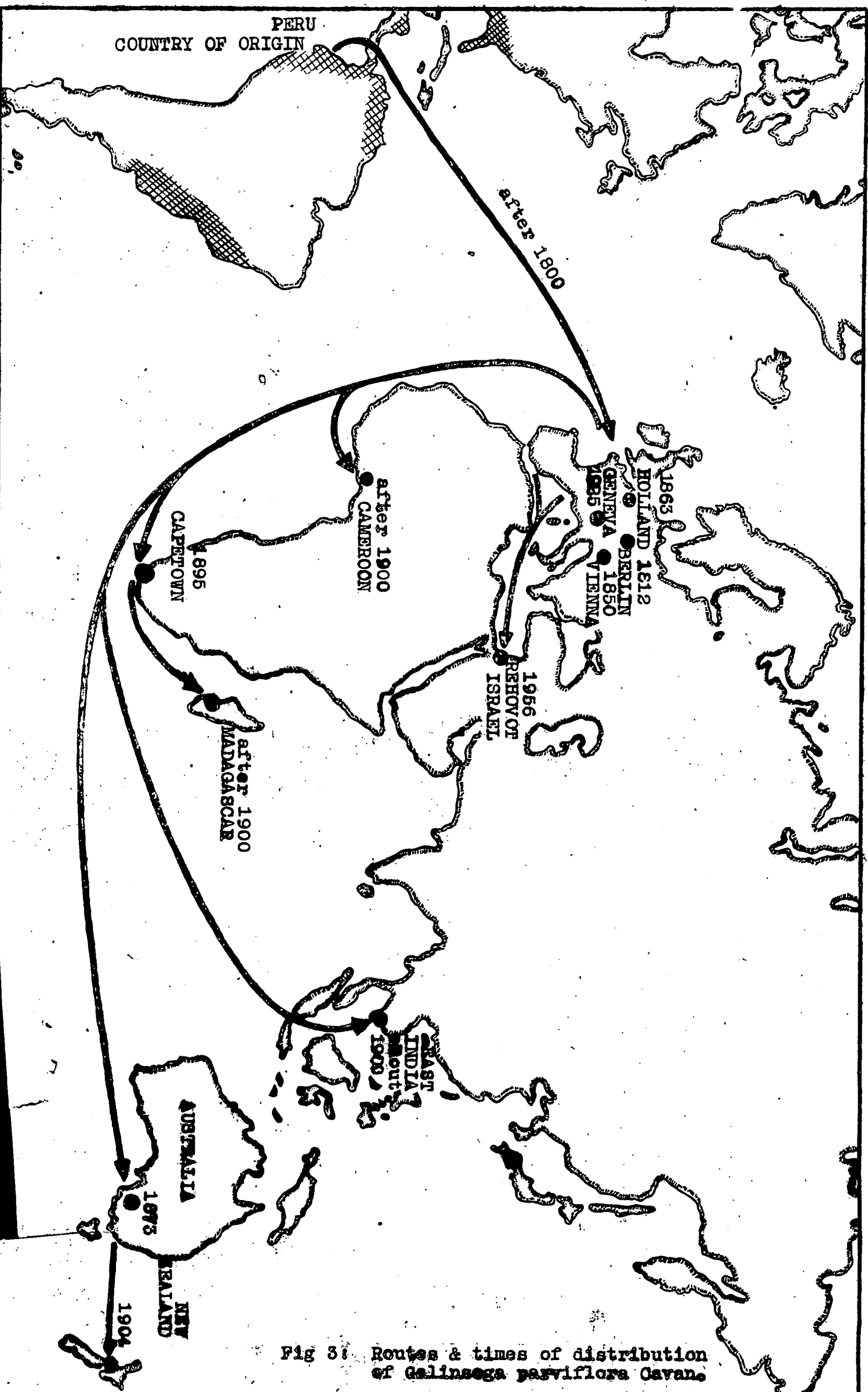


Fig 3: Routes & times of distribution of *Galinsoga parviflora* Cavan.

Its spread to the coffee-plantations of the East Indies is particularly interesting; there it finds the adequate conditions of a warm moist and shady habitat, where the canopy of the coffee-trees, planted in the shade of previously set-up shade-trees, provides double shady conditions.

#### Description of habitat in Rehovot:

When a new weed (is makes) its appearance it seems necessary to determine its ecological amplitude as far as possible, in order to be forewarned in respect to any potential danger. In the following the habitat in Rehovot is, therefore, described, and compared with habitats in other countries, in order to elucidate the prospects in this direction.

Up to now I found Galinsoga in the area of the Agricultural Research Station of Rehovot on 4 places, all in March 1956.

The first place (No. 1) where Galinsoga was noticed by me is to be seen in Fig. 4 in detail. It lies in the shadow of two palms of the genus Cocos and has a sandy soil with a rich toplayer of leafmulch and well rotted stable-manure of a light and very loose texture near two watertaps. The extremely plentiful winter rains of 1955/56 did not make irrigation necessary and its growth stage indicated to beginning of February as the time of its probable first germination. It was in full flower on March 6th and even had some seeds already but no wilted older individual yet. A patch of about 52 x 40 cm however was covered with a dense carpet of Galinsoga seedlings of 2-4 cm height around a watertap (see Table 3).

The cultivated flowers among which it was located are mostly Phlox, Vinca major, Verbena venosa, Scabiosa, Tagetes nana and Gaillardia. The record of the weed-flora among which it was found showed the following composition on March 12, 1956. (Table 2).



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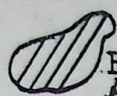
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LEGEND  
BOUNDARY OF SHDED AREA  
AT 11.30 a.m. ON MARCH 12.1956.

- GROUP OF 5 GALINSOGA INDIVIDUALS.
- SINGLE INDIVIDUALS.
- CARPET OF GALINSOGA SEEDLINGS.
- ⊗ WATERPIPE.

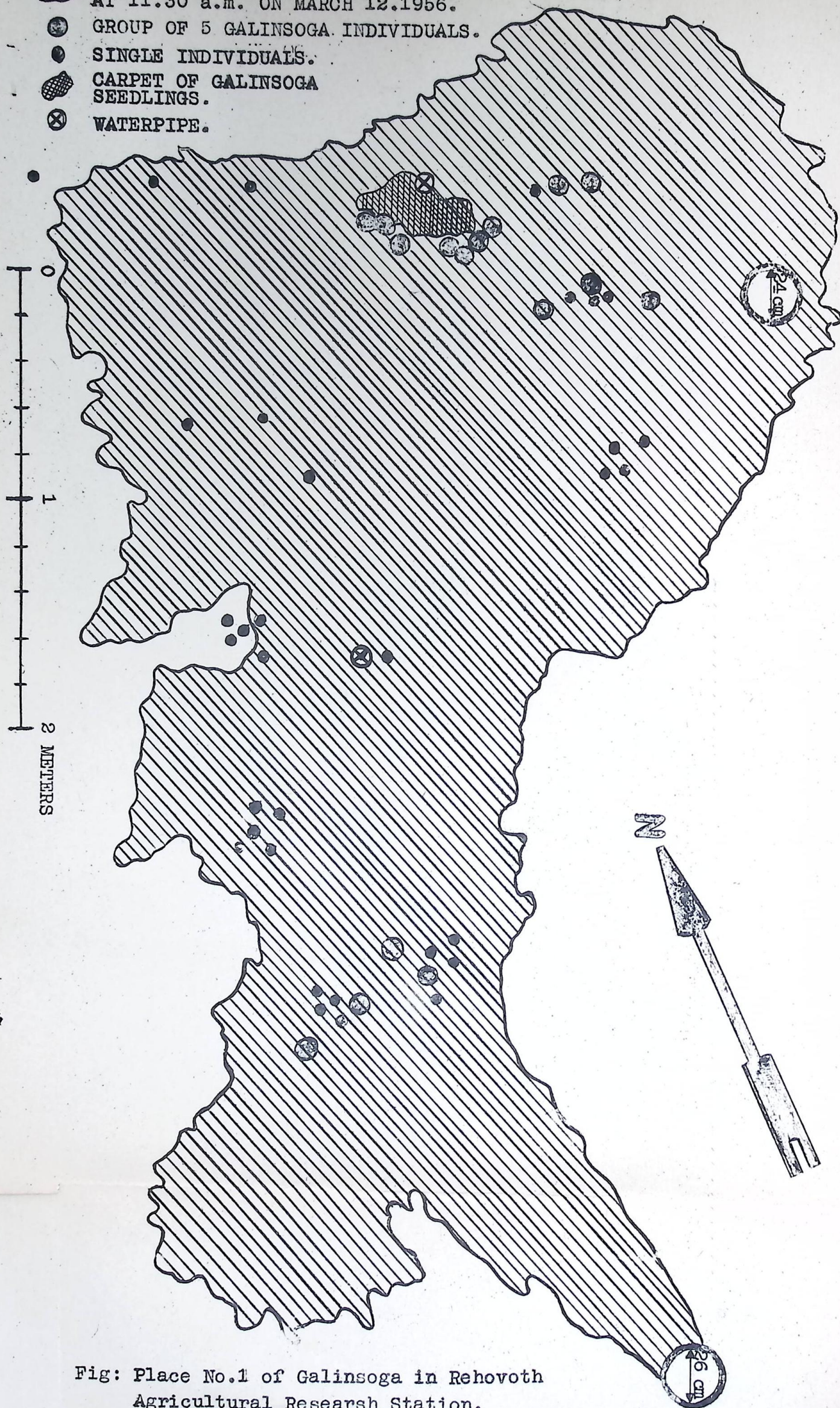


Fig: Place No.1 of Galinsoga in Rehovoth  
Agricultural Research Station.



On place No. 1 there occurred 123 individuals of the first generation already in the ripening stage on March 12th and as mentioned above on 6 dm<sup>2</sup> a dense carpet of seedlings partly budding and obviously a second generation at this early date. I counted 135 seedlings on one dm<sup>2</sup> (10 x 10 cm) i.e., a total of approximately 810 seedlings.

On place No. 2 there were 12, on place 3, 4 and on place 4, 3 flowering individuals, in March 1956, therefore, altogether a little less than 1000 individuals. Nearly all of them appeared in groups and in a dense bulk at place 1. 123 of them were of this year's first generation, and 810 of this year's second generation. This supports the assumption that this is a new occurrence here and probably in the whole of South West Asia, and taking into account the occurrence in the East Indies, the second known occurrence in the continent of Asia as a whole.

On April 7th we already found the first individuals in the garden of the Weizmann-Institute and in the garden of Yad Weizmann, both adjacent to the Agricultural Research Station.

The geographical distribution of the plants noted as accompanying weeds draws the attention to the close relation between the general Macro-distribution, i.e., the geographical distribution and the local Micro-distribution.

T A B L E II Plantsociological records of Place I and II  
(for description of habitat see text)

Date: March 12th, 1956. Place of I and II: Agricultural Research Station, Rehovot.

S P E C I E S	Place I						Place II					
	Individuals	Height in cm.	Abundance	Dominance	Sociability	Periodicity	Individuals	Height in cm.	Abundance	Dominance	Sociability	Periodicity
Galinsoga parviflora Cavan.	123	10-25	4	2	3	fl.fr.	12	10-12	3	1	1	fl.fr.
" " ,seedlings	810	2-5	5	5	5	fol.bud	-	-	-	-	-	-
Vicia amphicarpa Dorthes	1	15	1	1	1	for.	-	10	1	1	1	fol.
Lathyrus aphaca L.	1	15	1	1	1	fol.	-	-	-	-	-	-
Urtica urens L.	1	17	1	1	1	fl.	-	5	2	1	1	fol.fl.
Stellaria media (L.)Vill.	28	20	4	3	3	fl.	-	5	4	3	3	fl.fr.
Oxalis corniculata L.	7	5	4	3	3	fl.	-	2	3	2	3	fol.
Papaver rhoeas L.	2	20	2	1	1	bud	-	-	-	-	-	-
Rumex pulcher L.	1	22	1	2	1	fl.	-	-	-	-	-	-
Seneclo vernalis W.K.	1	18	1	1	1	fl.fr.	-	20	2	1	1	fl.fr.
Lathyrus ochrus (L.) DC.	1	22	1	1	1	fol.	-	-	-	-	-	-
Silene colorata Poir.	-	-	-	-	-	-	-	25	2	1	1	fl.
Daucus Broteri Ten.	-	-	-	-	-	-	-	7	1	1	1	fol.

T A B L E III

Plantsociological record for one square  
dm of the carpet of Galinsoga seedlings  
near the watertap on place No. 1.

(Dat: March 12th, 1956).

	Individuals	Height in cm	Abundance	Dominance	Sociability	Periodicity
Galinsoga seedlings	135	2-4	5	5	5	fol. (bud)
Stellaria media	2	16	5	1	5	fl., fr.

Table 4: Macrodistribution of the accompanying weeds of place 1 and 2.

<i>Lathyrus aphaca</i>	Omni-Mediterranean
<i>Urtica urens</i>	in temperate and warm areas of the globe with sufficiently high moisture and Nitrogen.
<i>Stellaria media</i>	Same as above
<i>Oxalis corniculata</i>	from Europe to omni Mediterranean to tropics on moist sites.
<i>Papaver rhoeas</i>	omni-Mediterranean-boreal
<i>Rumex pulcher</i>	" " "
<i>Lathyrus cichrus</i>	omni-Mediterranean
<i>Senecio vernalis</i>	Eastern Europe NE mediterr. Steppes of Eastern Europe.
<i>Daucus littoralis</i>	Continental influenced Mediterranean
<i>Silene Colerata</i>	" "

Apart from the last 3 species of this list all these plants have certain important features in common. Their macrodistribution is Mediterranean to humid-tropical and/or to humid and temperate areas with hot seasons in Europe, Siberia and in America. Not irrigated regularly till April, their appearance on this special plant-bed as also the appearance of *Galinsoga* was largely conditioned by the distribution of shade as to be seen from Fig. 4.

The shade is provided by some planted palm trees of various species which are distributed throughout this area of the garden and which shade all four places of all the habitats wherein the plants were found in

March 1956. (see Fig. 4 and 5).

(In the area of the Weizmann Institute and of Yad Weizmann the plants were situated on sunnier places, but treated with much more irrigation. They were accompanied there by weeds of higher temperature requirements as e.g. *Cyperus rotundus*).

*Senecio vernalis*, *Daucus Littoralis* and *Silene Colorata* are exceptions. *Senecio vernalis* has been observed in the last 50 years, wandering along the riverbeds of Central Europe in the opposite direction as *Galinsoga* - i.e. from the steppe regions of South East Europe into the more humid West, and is now meeting *Galinsoga* just on the border between the forest region and the steppe region. It occurs now in these steppe regions of Bohemia, Moravia and the basin of Vienna. (Beck-  
Managetta, Hegl). This macrodistribution of both species had clearly its parallel in their new meeting place in Rehovot, at least as long as the place is not regularly irrigated. *Senecio vernalis* appears here under the prevailing ecological circumstances of place No. 1, with the more humid features of the place in one single individual only and even this only in an elongated form with few leaves, whereas its normal occurrence is in the open places and mostly in large groups making its vivid yellow splashes all over such areas neighbouring Rehovot.

*Daucus littoralis* and *Silene colorata* are elements from the drier east-Mediterranean region, or more exactly, of the continentally influenced Mediterranean. They occur here together with *Galinsoga* in the sunnier place No. 2 and even there in one single individual only. Both of them are to be found in great numbers in open places of the coastal plain near Rehovot.

This meeting place of these two ecologically rather contrasting species groups in the limited area of a few square meters in comparison to their global distribution is an interesting example of the Geo-

ecological law of plant distribution (3) as applied to weed ecology. \*)

Plantgeographically we are here in Rehovot at a meeting place of the arid border forest belt (b. f. belt) and the Anatolian steppe region according to the new plantgeographical subdivision of Israel (2).

The shade conditions in February and March make the place climatologically fairly equivalent to general conditions of North Mediterranean and Southern Central European areas in midsummer as far as aridity is concerned. (Compare also figures on page 16).

Habitat No. 1 which has longer shaded day hours (on March 12 to 13 and again from 16 p.m.) shows Galinsoga in a more plentiful and better condition than in habitat 2 where there are but 5 hours of full sun at this date, provided that cloudiness is 0. Also the list of accompanying species indicates the shift of microclimatic conditions from a moister habitat (place 1) to a somehow dryer one (place 2).

According to Hegi (6) Galinsoga always appears in bulk especially in wellcultivated and wellmanured fields of potatoes, asparagus, hops, maize, onion, fruit gardens, and on light soils, lacking lime. A wet summer is likely to make it a pest as moisture and warmth are its main requirements. Owing to its very rapid development it can achieve in Europe 2-3 generations in one single warm season and its seedproduction is said to be fantastic and higher than that of any other weed.

One never knows how a weed may behave when conditions of its habitat are being altered. So, e.g. the re-transfer of European seed of Galinsoga to Peru brought about an eruptive development in this area, according to Garjeanne (6).

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\*) The Geoeecological law (Boyko 1947) reads in its shortened form: Microdistribution of an ecotype species is a parallel function of Macrodistribution since both are dependent on the same ecological amplitudes.



Germination requires a rather high temperature-minimum, a fact which can be deduced by comparing the seasons of germination and flowering in Europe and in Rehovot.

With regard to the temperature factor it seems that *Gelinsoga* can serve as a biological yardstick for the heat climate according to the principles of ecological climatology (Boyko, 3). The recorded flowering-time of August to September in Vienna dates germination time to June, July, August, i.e. the hottest time of the year. The temperature of these months in the areas of its occurrence are approximately the same as the temperatures were at germination time in the semi-shaded habitat of Rehovot in the warm February of 1956, (average  $19.9^{\circ}\text{C}$ ) and probably also in the double-shadow of coffee-trees and their shade trees in the humidtropics of the East-Indies as well as in tropical Africa and Madagascar.

The temperatures at soil-surface between February 1st and March 15th at the *Galinsoga* habitat in Rehovot most approximate those of Vienna in July, August, and September. Comparable micro-climatical measurements, the only applicable ones for such biological investigations are not available in either country. The mean maxima only may have some significance for a rough estimation of the ecological conditions for germination and establishment.

For the earliest germination month, i.e. quite generally the coolest possible, are as follows: \*)

Ekron (near Rehovot: February 1956 $19.9^{\circ}\text{C}$ ; Vienna: June aver. $20.0^{\circ}$					
March	"	$20.0^{\circ}\text{C}$ ;	"	July	" $22.9^{\circ}$
				August	" $22.3^{\circ}$

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\*) Data supplied by courtesy of the Meteorological Service, Government of Israel.

In Rehovot we estimate that germination must have occurred at the beginning of February, the second generation already at the beginning of March. It is intended to study the germination temperature-amplitudes in a climate-controlled room.

The parallelism of the geographical distribution with the ecological conditions on this local micro-distribution in Rehovot is thus further emphasized by comparison of these phenological facts in Vienna and in Rehovot.

#### Discussion and Summary:

A transition form between *Galinsoga parviflora* and *Galinsoga quadriradiata* has been found as newly immigrated to Israel. With this immigration the species is probably just beginning to conquer a new part of the world, Southwest Asia, after having established itself as a weed from Peru in many of the warmer parts of America and spreading from here first to Europe and from there to South Africa, East India, Australia and New Zealand in the course of about 150 years.

The ecological conditions of the new place as well as the accompanying species there indicate those of an encounter of a steppe and a temperate humid zone. The same is indicated by the macro-distribution of all species in its close vicinity, and by the phenological facts elucidating the Geoecological law of distribution. It is to be hoped that the invasion of *Galinsoga* into the Middle East will not start a new pest.

If we attempt to estimate the danger from *Galinsoga*, we believe that it may not be very great as yet in Israel; the reason for this lies in our relatively dry climate and the large amount of calcium in most of the soils. The potentially endangered areas therefore, are the light soils of the coastal plain, areas of irrigated crops with partial shade like Citrus, on well aired and manured soils and flower gardens. All botanists, agronomists, gardeners, and farmers are, therefore, advised to be on the look-out for a spreading of this weed.

Weed Control: Should the weed develop to dangerous proportions in Israel we should here already point out some possibilities of biological warfare for later control experiment.

According to H. Buhr (5) there exists a fungus parasite, *protomyces burenianus* n. sp., which has been found in Rostock parasiting on both *Galinsogas* but avoiding most other compositae.

Oil sprays did not seem very effective according to R. D. Sweet et alias (9). Treatment with Calcium citrate and Carbolineum looks successful. (Lindemuth 8).

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