Journal of
Plant Sciences

ISSN 1816-4951

Academic
Journals Inc.

www.academicjournals.com

Journal of Plant Sciences 5 (1): 33-40, 2010
ISSN 1816-4951 / DOI: 10.3923/jps.2006.14.21

Comparative Weed Density Studies in Irrigated Carrot (*Daucus carota* L.) Potato (*Solanum tuberosum* L.) and Wheat (*Triticum aestivum* L.) in Sokoto-Rima Valley, Sokoto State, Nigeria*

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Abstract: A survey of weeds commonly found in irrigated carrot (*Daucus carota* L.) potato (*Solanum tuberosum* L.) and wheat (*Triticum aestivum* L.) in Sokoto *Fadama* (latitude 13° 01'N and longitude 5° 15'E) was carried out during 2001/2002 and 2002/2003 dry seasons. A total of 38 major weed species were identified. Broad leaved weeds had the highest frequency (24 species) followed by grasses (11 species) and sedges (3 species). Highest density and proportions of most weeds species were found in carrot, followed by potato and only very few in wheat. Wild rice (*Oryza longistaminata* A. Chev and Roehr) and *Panicum subalbidum* (Kunth) were the grasses that occurred in all the three crops in both seasons. The broad leaved weeds that were common to all the three crops were *Amaranthus viridis* L., *Cleome*, *rutidosperma* (DC.), *Ipomoea aquatica* (Water spinach) Forsk. *Melochia cochorifolia* L. *Phyllanthus amarus* (Schum) (common purslane) and *Portulaca oleracea* (L.). *Amaranthus viridis* L. was the most frequent weed in all the crops during both seasons.

Key Words: Weed density, irigated, carrot, potato, wheat

Introduction

Weeds are subject to changes either in abundance or in the weed species presence in a locality over a period of time. *Fadama* soils are highly variable in terms of nutrient status and soil texture which may likely affect the nature of weed flora. The three crops (carrot, potato and wheat) are irrigated along hydromophic soil of Sokoto Rima Valley. Hoe weeding has been the usual practice of controlling weeds in the area. Successful weed control programmes in any crop can be achieved through good knowledge of the weeds present in that ecology. Understanding weed-crop interaction as well as the nature and functions of their interaction, will help in understanding the impact of crop production and husbandry practices on the shift in weed flora, particularly the persistence of some weeds in a given weed crop ecosystem (Akobundu, 1987). Variation in crop species strongly influences number and frequency of weeds in soil. Many weeds are just as varied in their habitat requirement as are crop plants (Akobundu, 1987). Some weeds and crops are site specific; others will thrive over a wide range of habitat. Many weed species closely associated with cultivated crops have requirements very similar to those of the crop. Weed shifts are known to occur in continuously cultivated land in response to tillage practice, cropping system, weed control and other changes in the habitat (Akobundu, 1987).

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*Originally Published in Journal of Plant Sciences, 2006

Weeds are important impediment to crop production because they are omnipresent and reduce crop yields. Weed control often constitutes the major cost of producing any crop especially in Africa (Orvin, 1983). Losses caused by uncontrolled weeds could be as high as 90% in carrot more than 50% in potato (Adeosun *et al.*, 2001) and 30-40% in wheat (Aderson, 1982). The objective of the study is to assess weed flora in irrigated carrot, potato and wheat fields along Sokoto Rima Valley of Northern Nigeria.

Materials and Methods

The survey was conducted in 2001/2002 and 2002/2003 dry seasons at the Usmanu Danfodiyo University,Teaching and Research *Fadama* Farm, Kwalkwalawa, Sokoto (13°1'N latitude and 5°15'E longitude). A total of 54 plots from each field of wheat, carrot and potato were systematically selected and pegged with 1 m^2 quadrate Prior to every weeding at 4, 8 and 12 WAP, weed samples within the 1 m^2 quadrate area were collected and counted from each plot in all the crops. The samples within the 1 m^2 quadrate area were separated by species and identified. Each weed species found within the 1 m^2 quadrate area was counted and recorded. Density or actual number of every weed species per unit area was determined by taking the average of the total number of that weed in each plot. Ecological analysis of the weed flora was carried out to determine the relative frequency and proportion according to Wirjahadja and Pancho (1975) using the equations below:

$$(1)\qquad \text{Relative frequency} = \frac{\text{Frequency value for one weed species}}{\text{Total frequency value for all weed species}} \times 100$$

$$(2)\qquad \text{Relative Density} = \frac{\text{Density of one weed species}}{\text{Total Density of all weed species}} \times 100$$

Results and Discussion

Weed Density

Irrigated carrot, potato and wheat in Sokoto *Fadama* were mostly infested by grasses, sedges and broad leaved weeds species. A total of 38 weed species were identified in the experimental sites during both trials. Out of these, 11 were grasses (29%), 23 broad leaved (61.5%) and only 3 sedges (7.9%) (Table 1). This distribution of the various weed species might be attributed to the hydromophic nature of the soil which provided conducive atmosphere for growth and development of both aquatic, semi aquatic and terrestrial weeds.

In carrot, about 12 weed species occurred at density of ≥ 10 plants m^{-2} during 2001/2002 trial. Out of these species, *Oryza longistaminata* had the highest density of about 71 plants m^{-2}, followed by *Ambrosia maritime, Chloris pilosa, Amaranthus viridis, Echinochloa obtuisiflora, Cyperus rotundus, Ipomoea aquatica, Eclipta prostrata, Acanthospermum hispidum, Echinochloa crus-pavonis. Eleusine indica* and *Paspalum scrobiculatum* also followed a decreasing order in their density during 2001/2002. In 2002/2003 trial, the density of most of these weeds decreased with the exception of *Amaranthus viridis* and *Cyperus rotundus* which showed a considerable increase in their density

Table 1: Density (number m^{-2} of weed species in irrigated carrot, potato and wheat fields along Sokoto Rima valley

	Carrot		Potato		Wheat	
Grasses	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003
Chiloris pilosa (Schum)	51	3	-	-	-	-
Cynodon dactylon (L.) Pers	7	18	12	13	-	-
Doctyloctenium aegyptium (L.)	9	20	-	-	-	-
Digitaria horizontalis (Wild)	5	7	-	-	-	-
Echinochloa crus-povonis (Schult)	13	31	-	-	-	-
Echinochloa obtusiflora (Staft)	34	57	-	-	-	-
Eragrostis tenella (L.)	-	-	7	4	-	1
Eleusine indica (L.) (Geartn)	12	10	5	12	-	-
Oryza longistaminata (A. Chev and Roehr)	71	58	26	33	82	49
Panicum subalbidum (Kunth)	7	20	5	4	-	1
Pospalum scrobiculatum (L.)	10	59	-	-	-	-
Broad leaved weeds						
Acacia seyal (L.)	-	-	5	5	1	-
Acalypha ciliata (Forsk)	-	-	2	6	-	1
Acanthospermum hispidum (Dc)	14	18	-	-	-	-
Ageratum conyzoides (L.)	-	-	16	-	-	-
Amaranthus spinosus (L.)	3	56	-	-	-	-
Amaranthus viridis (L.)	46	63	41	40	47	86
Ambrosia maritime (L.)	70	9	-	-	-	-
Azolla africana (Desv)	-	-	10	11	25	20
Cleome rutidosperma (Dc)	-	-	4	10	1	9
Cleome viscosa (L.)	2	28	-	-	-	-
Crotalaria retusa (L.)	-	29	-	-	-	-
Dissotis rotundifolia (Sm) Triana	-	-	6	4	1	4
Eclipta prostrata (L.)	17	36	-	-	-	-
Euphorbia hyssopifolia (L.)	2	-	-	-	-	-
Hibiscus asper (Hook F.)	-	-	-	6	-	1
Ipomea aquatica (Forsk)	22	8	5	8	4	2
Ludwigia abyssinica (A. Rich)	3	10	-	-	-	-
Melochia corchorifolia (L.)	3	12	12	33	1	3
Mimosa invisa (Mart)	2	-	-	-	-	-
Phyllanthus amarus (Schum)	7	6	4	3	1	2
Polygonum salicifolium (Brouss ex Wild)	3	34	-	-	-	-
Portulaca oleracea (L.)	2	44	23.4	34.2	4	28
Pilcaria crisps (L.)	-	-	4	3	1	1
Sida cordifolia	-	-	-	-	16	6
Sedges						
Cyperus difformis	2	4	3	13	25	-
Cyperus esculentus (L.)	-	-	18	14	-	-
Cyperus rotundus (L.)	25	50	15	15	-	-

by about 11.4 and 50%, respectively. Number of plants/m^2 of *Cynodon dactylon, Dactyloctenium aegyptium, Panicum subalbidum, Cleome viscosa, Eclipta prostrata, Ludwigia abyssinica, Polygonum salicifolium* and *Portulaca oleracea* increased in density from < 10 plants m^{-2} in 2001/2002 to >10 plants m^{-2} in 2002/2003. This might probably be due to higher temperature during the second trial which enhanced better weed germination and development.

In potato, up to 9 weed species recorded a density of >10 plants m^{-2} during the 2001/2002 trial. Out of these, *Amaranthus viridis* recorded the highest density of 41 plants/m^2 followed by *Oryza longistaminata, Portulaca oleracea, Cyperus esculentus, Melochia corchorifolia, Ageratum conyzoides, Cyperus rotundus, Cynodon dactylon* and *Azolla africana* which also followed a decreasing order in their density in 2001/2002 trial. Most of these weeds species showed a decrease in their density during 2002/2003 trial with the exception of *Portulaca oleracea, Melochia corchorifolia* and *Oryza longistaminata* which showed an increase in density of about 32.3, 48.4 and 21.2%, respectively.

Only 4 weed species recorded a density of more than 10 plants m^{-2} in wheat during 2001/2002 trial (Table 1). Out of these 4 species, *Oryza longistaminata* recorded the highest density of about 82 plants m^{-2} followed by *Amaranthus viridis*, *Azolla africana, Cyperus difformis* and *Sida chodifolia* which also followed a decreasing trend in their density in this trial. All of these weeds showed an increase in density during the 2002/2003 trial with the exception of *Oryza longistaminata* and *Azolla africana* which showed decrease in density of about 40 and 20%, respectively. Number of *Portulaca oleracea* increased from 4 plants m^{-2} in 2001/2002 to 28 plants m^{-2} in 2002/2003 trial.

The total density of weeds species per m^2 varied among the crops. Carrot had 50% more density than potato in both trials and 58.5 and 63.4% more weeds per m^2 than wheat in 2001/2002 and 2002/2003 trials, respectively (Table 1). High number of weeds were also found more in carrot than in both potato and wheat. Only three grasses were found in wheat. This high number of weeds species in carrot might be attributed to the fact that the crop provided poor shading due to its smaller leaves and takes longer time (about 21-28 days) before germination which gave the weeds an advantage to become well established before even the carrot's emergence. The earlier the weed emerges prior to the crop, the more time it has to establish and compete (Chapman, 2001). Few number of weed species in wheat might be as a result of its early germination, high seedling vigor, dense rooting system and inherent ability of forming tillers in 2-3 WAP within which most weeds did not germinate. All these attributes helped in providing excellent shading (than the other crops) and hence higher weed suppression ability. This agreed with Swaminatha (1980) who reported that wheat is good competitor with weeds and once established properly tend to outgrow the weed.

Relative Frequency

Table 2 shows the relative frequency of various weed species among the three irrigated crops. The result indicated that the rate of occurrence was relatively higher in carrot than in potato and wheat respectively as also noted in their density (Table 1). Higher weed occurrence was also observed in the first trial than in the second trial probably because of higher temperature recorded in the second trial which favoured the germination and growth of weeds.

Carrot was predominantly invaded by *Cynodon dactylon, Dactyloctenium aegyptium, Echinochloa crus-pavonis, Echinochloa obtusiflora, Oryza longistaminata, Panicum subalbidum, Paspalum scrobiculatum, Amaranthus viridis, Amaranthus maritime, Acanthospermum hispidum, Cleome rutidosperma, Eclipta prostrata, Ipomoea aquatica, Phyllanthus amarus* and *Cyperus rotundus*. Failure of the carrot leaves to suppress weed growth also contributed immensely to the appearance of many weed species. Only very few weed species occurred in <16.8% of the plots while *Eragrostis tennela, Acacia sayel, Acalypha cliata, Ageratum conyzoides, Azolla africana, Hibiscus asper, Palicaria crisps, Sida chordifolia* and *Cyperus esculentus* were not present in the crop during both trials. This high occurrence of both grasses and broad leaved weed in carrot will definitely reduce the yield and increase the cost of production.

Like carrot, potato was mostly invaded by *Cynodon dactylon, Oryza longistaminata, Acacia sayel, Ageratum conyzoides, Amaranthus viridis, Azolla africana, Melochia corchorifolia, Portulaca oleracea, Cyperus esculentus and Cyperus difformis* (Table 2). However, the level of occurrence was not as high as in carrot probably because potato sprouted earlier and suppressed the weeds through early canopy closure. Also, about 14 weed species occurred in carrot but were absent in potato in both trials. Among them were *Chloris pilosa, Dactyloctenium aegyptium, Digitaria horizontalis, Echinochloa obtusifora, Echinochloa crus-pavonis, Acanthospermum hispidum, Amaranthus spinosus* and many others.

Table 2: Relative frequency (%) of weed species in the irrigated carrot, potato and wheat fields along Sokoto Rima valley

	Carrot		Potato		Wheat	
Grasses	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003
Chiloris pilosa (Schum)	18.2	25.8	-	-	-	-
Cynodon dactylon (L.) Pers	32.6	46.2	29.2	34.6	-	-
Doctyloctenium aegyptium (L.)	25	4.9	-	-	-	-
Digitaria horizontalis (Wild)	14.5	33.9	-	-	-	-
Echinochloa crus-povonis (Schult)	28.3	46.8	-	-	-	-
Echinochloa obtusiflora (Staft)	47.9	61	-	-	-	-
Eragrostis tenella (L.)	-	-	28.9	24.4	-	1
Eleusine indica (L.) (Geartn)	36.9	35	27.7	34.6	-	-
Oryza longistaminata (A. Chev and Roehr)	49.3	54.5	35	42.3	65.9	61.4
Panicum subalbidum (Kunth)	21	45.6	26.8	32.4	-	1.6
Pospalum scrobiculatum (L.)	38.5	62.3	-	-	-	-
Broad leaved weeds						
Acacia seyal (L.)	-	-	26.6	35.7	5.5	-
Acalypha ciliata (Forsk)	-	-	8.3	28	-	1
Acanthspermum hispidum (Dc)	31.3	32.7	-	-	-	-
Ageratum conyzoides (L.)	-	-	33.6	36	-	-
Amaranthus spinosus (L.)	27.1	44.8	-	-	-	-
Amaranthus viridis (L.)	35.6	67.8	37.6	43.8	63.1	78.7
Ambrosia maritime (L.)	35.7	45.2	-	-	-	-
Azolla africana (Desv)	-	-	28.9	36.9	44.4	55.2
Cleome rutidosperma (Dc)	15.7	50.5	-	-	-	-
Cleome viscosa (L.)	-	-	20.2	32.1	2.8	14.4
Crotalaria retusa (L.)	-	48.9	-	-	-	-
Dissotis rotundifolia (Sm) Triana	-	-	25.5	28.9	3.5	19.4
Eclipta prostrata (L.)	36.3	54.3	-	-	-	-
Euphorbia hyssopifolia (L.)	3.8	-	-	-	-	-
Hibiscus asfer (Hook F.)	-	-	-	26.4	-	1.6
Ipomea aquatica (Forsk)	38	40	23.9	28.1	11	14.5
Ludwigia abyssinica (A. Rich)	13.8	41.8	-	-	-	-
Melochia corchorifolia (L.)	16	39.4	32.4	40.3	4.3	15.1
Mimosa invisa (Mart)	15.4	-	-	-	-	-
Phyllanthus amarus (Schum)	27.4	39.4	24.9	24	6.4	13.8
Polygonum salicifolium (Brouss ex Wild)	17.5	49.7	-	-	-	-
Portulaca oleracea (L.)	16	54.5	33.6	41	15.4	62.9
Pilcaria crisps (L.)	-	-	21.2	25.2	27.2	1.6
Sida cordifolia	-	-	-	-	48.7	37
Sedges						
Cyperus difformis	15.7	29.5	26.5	38.1	27.1	-
Cyperus esculentus (L.)	-	-	34.2	31	-	-
Cyperus rotundus (L.)	32.3	51.7	32.4	33.6	-	-

Wheat plots were invaded by *Oryza longistaminata, Azolla africana* and *Portulaca oleracea*, in both trials. About 18 weed species were found to be absent in wheat but present in either carrot and or potato in both trials. The low occurrence of most weed species in wheat might probably be due to the fact that wheat germinated earlier than most weeds and about 14 days earlier than carrot and potato, its highier seedling vigour, its good plant architecture and its inherent ability of forming tillers in 2-3 weeks after planting (the time at which both carrot and potato are still germinating) gave it a better advantage of competing with weeds compared to these other crops.

Across the crops, the most distinct occurring weed was *Amaranthus viridis* followed by *Oryza longistaminata, Melochia corchorifolia* and *Ipomoea aquatica*. High occurrence of *Amaranthus viridis* among all crops might be attributed to its early germination, efficient and high seed production as well as its plasticity (Akobundu, 1987). High occurrence of *Oryza longistaminata* among

all crops may be attributed to the fact that, it can be propagated by both seeds and rhizomes. High occurrence of this weed in carrot and potato can be a biggest threat to these crops, because apart from the above and below ground competition with these crops the underground protruding rhizomes can easily injure the storage organs of these crops. This can not only reduce their market value but also their shelf life.

Relative Density

In carrot plots only five weed species occurred at relative density of ≥ 4% in 2001/2002 trial (Table 3). Of these, *Oryza longistaminata* produced the highest density relative to *Echinochloa obtusiflora, Cyperus rotundus, Eclipta prostrata* and *Echinochloa crus-povonis* in decreasing order during 2001/2002. In 2002/2003 trial, *Amaranthus viridis* increased its density by more than 50%

Table 3: Relative density (%) of weed species in the irrigated carrot, potato and wheat fields along Sokoto Rima valley

	Carrot		Potato		Wheat	
Grasses	2001/2002	2002/2003	2001/2002	2002/2003	2001/2002	2002/2003
Chiloris pilosa (Schum)	1.5	1	-	-	-	-
Cynodon dactylon (L.) Pers	1.8	2.9	5.4	4.2	-	-
Doctyloctenium aegyptium (L.)	3.6	3.5	-	-	-	-
Digitaria horizontalis (Wild)	1.3	4.1	-	-	-	-
Echinochloa crus-povonis (Schult)	4.2	7.3	-	-	-	-
Echinochloa obtusiflora (Staft)	9	8.9	-	-	-	-
Eragrostis tenella (L.)	-	-	3.2	1.6	-	0.1
Eleusine indica (L.) (Geartn)	3.2	1.6	2.4	3.9	-	-
Oryza longistaminata (A. Chev and Roehr)	16.2	10.4	1.2	10.5	40.4	18.3
Panicum subalbidum (Kunth)	2.4	3.3	2.5	1.1	-	0.1
Broad leaved weeds						
Acacia seyal (L.)	-	-	2.4	1.6	0.4	-
Acalypha ciliatea (Forsk)	-	-	0.9	1.8	-	0.1
Acanthspermum hispidum (Dc)	3.2	2	-	-	-	-
Ageratum conyzoides (L.)	-	-	7.2	3.5	-	-
Amaranthus spinosus (L.)	0.8	9.1	-	-	-	-
Amaranthus viridis (L.)	3.1	13	11.7	9.8	18.7	57.6
Ambrosia maritime (L.)	2.7	13	-	-	-	-
Azolla africana (Desv)	-	-	4.6	3.4	11.9	6.4
Cleome rutidosperma (Dc)	0.6	5.1	-	-	-	-
Cleome viscosa (L.)	-	-	2	3.2	0.1	2.2
Crotalaria retusa (L.)	-	3.8	-	-	-	-
Dissotis rotundifolia (Sm) Triana	-	-	2.8	1.4	0.5	1.6
Eclipta prostrata (L.)	4.4	5.7	-	-	-	-
Euphorbia hyssopifolia (L.)	0.8	-	-	-	-	-
Hibiscus asper (Hook F.)	-	-	-	1.8	-	0.7
Ipomoea aquatica (Forsk)	5	1.2	2.1	2.8	2.1	0.6
Ludwigia abyssinica (A. Rich)	0.8	1.5	-	-	-	-
Melochia corchorifolia (L.)	0.8	3.7	7.8	10.7	0.4	1
Mimosa invisa (Mart)	0.8	-	-	-	-	-
Phyllanthus amarus (Schum)	1.8	1.3	1.8	1.2	0.8	0.6
Polygonum salicifolium (Brouss ex Wild)	0.9	4.4	-	-	-	-
Portulaca oleracea (L.)	0.7	5.5	10.8	10.8	2.8	9.8
Pilcaria crisps (L.)	-	-	2	1.1	1.2	0.1
Sida cordifolia	-	-	-	-	8.9	2
Sedges						
Cyperus difformis	0.5	1	1.6	4.1	1.5	-
Cyperus esculentus (L.)	-	-	8.6	4.3	-	-
Cyperus rotundus (L.)	6.6	9.1	6.8	5.6	-	-

while that of *Oryza longistaminata* and *Echinochloa obtusiflora* decreased considerably. The relative density of *Echinochloa crus-povonis*, *Eclipta prostrata* and *Cyperus rotundus* was also fairly increased during 2002/2003 trial. Weed species with <4% relative density in 2001/2002 trial were observed to have increased their density to ≥4 in 2002/2003. These species include *Ambrosia maritime*, *Amaranthus spinosus, Portulaca oleracea*, *Cleome viscoa, Polygonum salicifolium* and *Digitaria horizontalis* which also followed decreasing order of density.

In potato field, up to 9 weed species occurred at relative density of ≥4% in 2001/2002 trial (Table 3). Of these, *Oryza longistaminata* had the highest density relative to *Amaranthus viridis, Portulaca oleracea, Cyperus esculentus, Melochia corchorifolia, Acanthspermum hispidum, Cyperus rotundus, Cynodon dactylon* and *Azolla africana* which follow a decreasing order of density in the same trial. The success of *Oryza longistaminata*, in this respect could be attributed to its ability to be propagated by both seeds and rhizomes. A considerable decrease in density was also recorded for these weeds in 2002/2003 trial with the exception of *Melochia corchorifolia* which recorded a considerable increase of about 30% and *Portulaca olaracea* which maintained stable density of 10.8% in both trials. Relative density of *Cyperus difformis* was also increased from 1.6% in 2001/2002 to 4.1% in 2002/2003 trial.

About 5 weed species occurred at density of ≥ 4% during 2001/2002 trial in wheat field (Table 3). Of these, *Oryza longistaminata* produced the highest density relative to *Amaranthus viridis*, *Azolla africana*, *Cyperus difformis* and *Sida chordifolia* which followed a decreasing order of relative density in this trial. A considerable decrease in density was also recorded for all of these weeds in 2002/2003 trial except *Amaranthus viridis*, which shared an increase in density of about 68% and *Cyperus difformis*, which fail to appear in this trial. This highest increase of *Amaranthus viridis* might be attributed to its high growth rate and percundity.

Conclusions

Field observations in both trials indicated a wide spread occurrence, high density and proportion of most weeds in carrot and potato than in wheat. This is because wheat crop germinated and developed faster than these other two crops. It can be concluded that pre-planting/selective weed control measure will be more preferable than the post planting/hoe weeding in carrot and potato. High density of *Oryza longistaminata* can cause a considerable loss to carrot and potato due to competition and injuries caused by the protruding rhizomes to the underground storage organs of these crops. This call for pre-plant weed control to eliminate this weed before the emergence of these crops.

References

Adeosun, J.O., R.A. Gbadegesin, J.E. Oyinba, W.B. Ndahi and J.J. Amos, 2001. Influence of nitrogen and period of weed interference on yield and growth of upland rice. J. Agric. Environ., 2: 63-73.

Aderson, R.L., 1992. Effect of duration of jointed goat grass interference on winter wheat grain yield. Research Proceedings of Weed Science, pp: 3.

Akobundu, I.O., 1987. Weed Science in the Tropics: Principles and Practices. John Willey and Sons, pp: 525.

Chapman, B., 2001. Effect of Weed in Wheat. Top Document. Agricultural Food and Rural Development, pp: 25.

Orvin, C.B., 1993. Weed Science-The Step Child. Weed Technol., 7: 515-518.

Swaminatha, M.S., 1980. Perspective in World Agriculture. The Gresher Press, pp: 7-8.

Wirjahdja, S.D. and J.Y. Pancho, 1978. Weed survey sampling method and vegetation analysis. Biotrop. Tech. Bull., 4: 20.