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Bioenergetics: Open Access

Research

Seed Features of Selected Arable Weeds of Ondo State Agriculture, Nigeria

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ABSTRACT

The study was conducted at The Federal University of Technology Akure in 2011 aimed at evaluating the influence of weed seed features (seed size and weight) on their persistence on cropland. Weeds are one of the main problems affecting agriculture in Nigeria. Annual weeds produces many seeds yearly, contributing largely to the next season's weed emergence on the cropland. Weeds are tolerant to environmental stresses, reproducing by seed or underground stems (rhizomes, stolon, tuber, bulb, stem). Some of its competitive ability in cropland are Mimicry, mis-identification and seedling vigour with seed survival an influencing factor to their population dynamics. Weed seed were collected from various cropland and field where different factors affected their growth, seed size, seed number and establishment. The average weight, length and width were derived and preliminary germination test done to obtain basic information on seed viability and or dormancy at harvest from field plots. Germination counts were then recorded. Weed seed ranges from a minimum of <1 mm length in Cyathula prostate, Elusine indica and Pennisetum pedicellatum to a maximum of 10.5 mm in Bidens pilosa. Also, seed width varies between <1 mm width in Cyathula prostate, Ageratum conyzoides, Emilla coccinea, Tridax procumbens, Maricus longibracteatus, Elusine indica and Pennisetum pedicellatum to a maximum of 3.7mm in Centrosema pubescens. However, Amarathus spinosus (5 ×10-5 g), Sida acuta (3.3 ×10-2 g) had the least and highest seed weight respectively. Bigger and heavier seeds (Rottboellia cochinchinensis, Penisetum pedicellatum, Centrosema pubescens) have higher percentage germinatioin.

Keywords: Seed size; tolerant; weed; weed seed

INTRODUCTION

Weeds are one of the main problems affecting agriculture in Nigeria. Weeds are plants that interfere with human activities, or intrude upon human welfare (Akohundu, 1987). Weeds been defined by France Boyer and Richard Dickson in their book "Weeds of the Northern U.S. and Canada" (1999) is in three perspectives which includes agriculture, suburban and ecology. The agricultural perspective sees a weed as a plant which competes with crop for nutrients, moisture and lowers crop yield or causes crop failure. Suburban perspective however defines it as any plant that invades the lawn and garden of suburban home-owners and other managed landscapes of the mainstream society. While ecological perspective considers it as any plant that thrives in a degraded habitat with a history of disturbance through human agency.

The reserves of viable seeds in soil both at the depth and surface are known as seed bank (Gomes and Christoffoleti, 2008). The soil seed bank is the primary source of weeds in arable land with most of its seed from arable weeds (Sjursen et al., 2008). Its the sum of all seeds produced and introduced over time both alive and dormant (Kuva et al., 2008).

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Received date: October 19, 2020; **Accepted date:** August 25, 2021; **Published date:** September 6, 2021

Citation: Umoh FM (2021) Seed features of selected arable weeds of Ondo State agriculture, Nigeria. Bioenergetics Vol.9.No.p374.

Annual weeds produces large seeds yearly thus contributing largely to the next season's weed emergence on the field (Jacob et al., 2006). Unlike crops, weeds are tolerant to the environmental stresses (Kim et al., 1999). Weeds can reproduce quickly by seed or by underground stems (rhizomes, stolon, tuber, bulb, stem). Seed features such as seed weight, presence of pappus, size (length and width), volume, colour and texture aid their dispersal. Mimicry, mis-identification, seedling vigour are some of its competitive ability in cropland. Seed survival therefore is a factor influencing their population dynamics (Davis et al., 2004).

Seed being the beginning and end of the life cycle of many weeds, they tend to be extremophites for example Echinochloa oryzochloa is relatively more tolerant to salt (Kim et al., 1999). This attribute makes seeds the ultimate means of survival of species. The seed therefore, plays an important role in survival and multiplication of weeds. The dormancy state of weed seeds changes from dormancy to non-dormancy, creating future weed problems, thus weed scientists believe dormancy as a dispersal mechanism through time (Fabian, 2008)

The objective of this study was therefore, to collect data on the seed size and weight of selected arable weeds of south-western Nigeria, with a view to evaluating the influence of these seed features on their persistence on cropland.

MATERIALS AND METHODS

The study was carried out on seedlots collected randomly from 22 arable weeds on cropped fields from The Federal University of Technology, Akure (Long. 7° 16°E, Lat, 5° 12°'N: 327m above sea level) in the Rainforest belt of South-Western Nigeria, between November and December, 2011.

Table 1a: Characteristics of selected arable weed specie.

S/N	Plant Family	Weed Species	Growth Habit
1	Amaranthaceae	Amaranthus spinosus L	ABL
		Cyathula prostate (L)	ABL
2	Asteraceae	Ageratum conyzoides (L)	ABL
		Aspilla Africana (pers.) C. D Adams	ABL
		Bidens pilosa L.	ABL
		Emilla coccinea	ABL
		Synedrella nodiflora Gaertn.	ABL
		Tithonia diversiflora (Hemsl.) A. Gray	ABL
		Tridax procumbens L.	ABL
3	Cyperaceae	Mariscus longibracteatus Kunth	PS
4	Euphorbiaceae	Euphorbia heterophylla L	ABL
5	Fabaceae	Calopogonium mucunoides L	ABL
		Centrosema pubescens Benth (Wild.)	PBL
6	Malvaceae	Corchorus corchorifolia L	ABL
		Sida acuta Blurm. F	PBL
7	Mimosaceae	Mimosa pudica L	PBL

ABL= Annual Broadleaf, PBL= Perennial Broadleaf, AG= Annual Grace, PG= Perennial Grass, PS= Perennial Sedge

Table 1b: Characteristics of selected arable weed specie.

S/N	Plant family	Weed specie	Growth habit
8	Poaceae	Axanopus compressus (Sw.)	PG
		Eleusine indica (Gaettn)	AG
		Panicum maximum Jacq.	PG
		Paspalum orbsiculare Forst.	PG
		Pennisetum pedicellatum Trin.	AG
		Rottboellia cochinchinensis (Lour.)	AG

ABL= Annual Broadleaf, PBL= Perennial Broadleaf, AG= Annual Grace, PG= Perennial Grass, PS= Perennial Sedge

Table 2a: Number of seeds used in linear and weight determination.

S/N	Weed Specie	Seed Length	Seed width	Seed Weight
1	Rottboellia cochinchinensis	6	6	10
2	Amaranthus spinosus	6	6	20
3	Cyathula prostate	6	6	20
4	Ageratum conyzoides	6	6	20
5	Aspilla Africana	6	6	10
6	Bidens pilosa	6	6	20
7	Emilla cocoinea	6	6	2
8	Synedrella nodiflora	6	6	10
9	Tithonia diversiflora	6	6	20
10	Tridax procumbens	6	6	10
11	Mariscus longibracteatus	6	6	20
12	Euphorbia heterophylla	6	6	2
13	Calopogonium mucunoides	6	6	20
14	Centrosema pubescens	6	6	20
15	Corchorus corchorifolia	6	6	20
16	Sida acuta	6	6	20

Table 2b: Number of seeds used in linear and weight determination.

S/N	Weed Specie	Seed Length	Seed width	Seed Weight
17	Rottboellia cochinchinensis	6	6	20
18	Axanopus compressus	6	6	10
19	Eleusine indica	6	6	10
20	Panicum maximum	6	6	3
21	Paspalum orbsiculare	6	6	20
22	Pennisetum pedicellatum	6	6	20

Table 3: Number of seeds per reproductive structure in some selected weed species.

S/N	Weed Species	Samples				
		1	2	3	4	5
1	Tithonia diversiflora	81	42	70	75	58
2	Corchorus corchorifolia	69	70	86	70	78
3	Calopogonium mucunoides	6	7	5	7	7
4	Centrosema pubescens	10	12	16	14	16

Table 4a: Average seed length, width and air-dry weight for selected arable weed specie.

S/N	Plant Family	Weed Species	Average seed Length(mm)	Average Seed width(mm)	Average Weight (g)
1	Amaranthaceae	Amaranthus spinosus	1.0	1.0	5.0×10-5
		Cyathula prostate	<1	<1	2.4×10-3
2	Asteraceae	Ageratum conyzoides	1.8	<1	1.2×10-4

		Aspilla Africana	4.0	1.5	1.6×10-3
		Bidens pilosa	10.5	1.0	2.0×10-3
		Emilla coccinea	3.0	<1	1.0×10-3
		Synedrella nodiflora	4.0	1.3	8.0×10-4
		Tithonia diversiflora	6.5	2.5	2.8×10-2
		Tridax procumbens .	4.8	<1	1.3×10-4
3	Cyperaceae	Mariscus longibracteatus	1.7	<1	5.0×10-4
4	Euphorbiaceae	Euphorbia heterophylla	2.3	2.2	9.9×10-3
5	Fabaceae	Calopogonium mucunoides	3.7	2.8	1.1×10-2
		Centrosema pubescens	4.8	3.7	3.1×10-2
6	Malvaceae	Corchorus corchorifolia	2.0	1.7	4.7×10-4
		Sida acuta	2.0	1.0	3.3×10-2
7	Mimosaceae	Mimosa pudica	4.0	3.3	4.5×10-3

Table 4a: Average seed length, width and air-dry weight for selected arable weed specie.

S/N	Plant family	Weed specie	Average seed Length(mm)	Average Seed width(mm)	Average Weight (g)
8	Poaceae	Axanopus compressus	1.3	1.0	6.3×10-4
		Eleusine indica	<1	<1	3.8×10-4
		Panicum maximum	3.2	1.7	1.6×10-3
		Paspalum orbsiculare	2.2	1.7	9.4×10-4
		Pennisetum pedicellatum	<1	<1	4.0×10-4
		Rottboellia cochinchinensis	5.8	3.2	1.2×10-2

Table 5: Categories of the selected weed species in the different ranges.

		Weed species
Length (mm)	<1	C. prostate, E. indica, P. pedicellatum
	1.0-4.8	A. Africana, A. spinosus, A. conyzoides, M. longibracteatus, E. heterophylla, E. coccinea, S. nodiflora, T. procumbens, C. mucunoides, C. pubescens, S. acuta, C. corchorifolia, M. pudica, A. compressus, P. maximum, P. orbsiculare
	4.9-10.5	B. pilosa, T. diversiflora, R. cochinchinensis
Width (mm)	<1	C. prostate, A. conyzoides, E. coccinea, T. procumbens, M. longibracteatus, E. indica, P. pedicellatum
	1-2	A. spinosus, A. Africana, B. pilosa, S. nodiflora, C. corchorifolia, S. acuta,, A. compressus, P. maximum, P. orbsiculare

	2-4	T. diversiflora, E. heterophylla, C. mucunoides,, C. pubescens, M. pudica, R. cochinchinensis
Weight (g)	1×10 -4 - 5.0×10-4	A. spinosus, T. procumbens, E. indica, C. corchorifolia, P. pedicellatum
	6×10-4 - 5×10-3	C. prostate, A. conyzoides, A. Africana, B. pilosa, E. coccinea, S. nodiflora, M. longibracteatus, M. pudica, A. compressus,, P. maximum, P. orbsiculare
	1×10-2-5×10-2	T. diversiflora, E. heterophylla, C. mucunoides,, C. pubescens, S. acuta, R. cochinchinensis

Table 6: Seed germination rate in some selected weed specie.

Weed	Number of treated seeds	Onset of seed germination	Percentage germination
Rottboellia cochinchinensis	5	3	60
Centrosema pubescens	15	3	24
Corchorus corchorifolia	20	3	15
Pennisetum pedicellatum	20	5	30
Cyathula prostate	10	6	10
Mimosa pudica	10	7	10
Calopogonium mucunoides	20	14	13
Aspilla Africana	5	14	5
Sida acuta	10	3	10

Appendix a: Linear measurement and wet weight of selected arable weeds.

S/N	Weed Specie	Length (mm)	Width (mm)	Weight (g)
1	Amaranthus spinosus	1	1	0.001
2	Cyathula prostate	0.9	0.3	0.048
3	Bidens pilosa	10.2	1	0.041
4	Aspilla Africana	3.2	1.3	0.018
5	Ageratum conyzoides	1.3	0.1	0.003
6	Emilla coccinea	3	0.7	0.002
7	Synedrella nodiflora	4	1.3	0.008
8	Tithonia diversiflora	6.5	2.5	0.209
9	Tridax procumbens .	4.8	0.3	0.001
10	Calopogonium mucunoides	3.7	2.8	0.259
11	Euphorbia heterophylla	2.3	2.1	0.124
12	Mariscus longibracteatus	1.7	0.3	0.01
13	Centrosema pubescens	4.8	3.7	0.58
14	Corchorus corchorifolia	2	1.7	0.01
15	Sida acuta	2	1	0.042
16	Mimosa pudica	4	3.3	0.092
17	Axonopus compressus	1.3	1	0.006
18	Eleusine indica	0.1	0.1	0.004
19	Rottboellia cochinchinensis	5.8	3.2	0.124

20	Panicum maximum	3.2	1.7	0.005
21	Pennisetum pedicellatum	0.1	0.1	0.006
22	Paspalum orbsiculare	2.2	1.7	0.014

Table 1, 2 and 3 shows the growth characteristics of the weed species, number of seeds used in the linear and weight determination and the seed-production capacity of some selected species respectively.

Seed size (length and width) were determined by using a millimeter ruler while seed weight was determined using the weighing balance.

The average weight (AVW), average length (AVL) and average width (AVW) of the seeds were derived from the following formula:

$$AVW = \frac{\text{Weight}}{\text{No. of seeds weighed}}$$

$$AVL = \frac{\text{Total length}}{\text{No. of seeds measured}}$$

$$AVW = \frac{\text{Total weight}}{\text{No. of seeds measured}}$$

Preliminary germination test was done to obtain basic information on the influence of seed characteristics on seed viability and or dormancy status at harvest from field plots. Weed seeds collected randomly from the field were placed in a petric dish lined with serviette paper and moisture with 10ml of distilled water.

Two replicate per weed specie were placed in a petric dish on the laboratory benches and allowed to germinate under laboratory conditions.

Germination counts were recorded at two-day intervals for seven days after treatment.

Percentage (%) germination was calculated as

$$\frac{\textit{Number of germinated seeds}}{\textit{Total number of treated seeds}} \times 100$$

RESULTS & DISCUSSION

Seed size represents a huge investment made by the maternal plant (Grundy et al., 2003).

Weed seed ranges from a minimum of <1 mm length in Cyathula prostate, Elusine indica and Pennisetum pedicellatum to a maximum of 10.5 mm in Bidens pilosa (Table 4.), Also, seed width varies between <1 mm width in Cyathula prostate, Ageratum conyzoides, Emilla coccinea, Tridax procumbens, Maricus longibracteatus, Elusine indica and Pennisetum pedicellatum to a maximum of 3.7mm in Centrosema pubescens. However, Amarathus spinosus (5 ×10-5 g), Sida acuta (3.3 ×10-2 g) had the least and highest seed weight respectively.

Identifying a single measure of seed size for use as a parameter is difficult, although seed mass (i.e. seed weight excluding any dispersal mechanisms), as used in the present study, has been suggested as the best measure of resource availability (Westonby 1998).

It was deduced from Table 6 that high percentage of most weed seeds germinated after 3 days. Bigger and heavier seeds (Rottboellia cochinchinensis, Penisetum pedicellatum, Centrosema pubescens) have higher percentage germinatioin. This is supported by the findings by Grundy who stated that larger and heavier seeds has higher germination and emergence in greater sowing depths (Grundy, 2003). Similarly, Benvenuti et al., reported an inverse relationship between seed weight and depth-mediated inhibition in several weed species (Benvenuti et al., 2001).

The variations in seed size and weight confirm previous report on the wide variations in seed characteristics among weed species and the effect of these characteristics on weed seed germinability (Weimark, 1975).

However, dormancy tendencies are greater in smaller-seeded species, they make use of the limited reserves thus germinating when a favourable condition for survival and establishment (Grundy et al., 2003). This supports the theory that smaller-seeded species generally have a more rapid relative growth rate to exploit their establishment opportunities (Leishman et al. 2000).

This can also be a weakness, as they are more prone to physical damage. This may contribute to the high percentage mobility in the laboratory experiment even at low depth.

A further hypothesis was thus formulated and tested which states that seed size may not be only involved in the germinability and emergence but may also be responsible for tolerance to soil compaction (Benvenuti and Mazzoncini, 2019).

Similarly, Weimark (1975) reported that larger-sized seeds germinated better than medium-sized and small-sized seeds, and seedlings from large seed had a higher survival rate than those from small seeds under field conditions. Moreover, seed size is positively correlated with seed vigour and a larger-sized seeds tends to produce a more vigorous seedling. Seeds are the link between two successive generations of plants. They allow the plant to survive periods in which conditions are not optimal to complete its life cycle but also allow it to be transported to new locations. Seeds multiply, spread and perpetuate the species; they are viable to species which lack vegetative means of propagation and vary in importance in those which do regenerate in this way.

While this relationship has been recognized, few studies have attempted to incorporate this parameter in predictive weed species emergence models (Grundy et al., 2003). An exception is Vleeshouwers (1997) where, along with soil penetration resistance, seed weight was included in a model of pre-emergence growth of weed seedlings from different burial depths.

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