



بسم الله الرحمن الرحيم



Sudan University of Sciences and Technology

College of Agriculture Studies

Department of Plant Protection

Assessment of Soil Seeds Bank in Uncultivated Area

(Shambat)

تقدير بنك بذور الحشائش في ارض غير مزروعة (شمبات)

A thesis submitted in partial fulfillment of the requirements for the
degree of B.Sc. in plant Protection

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الاية

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

(قَالَ تَزْرَعُونَ سَبْعَ سِنِينَ دَأْبًا فَمَا حَصَدْتُمْ فَذَرُوهُ فِي سُنْبُلِهِ إِلَّا قَلِيلًا مِّمَّا
تَأْكُلُونَ)

صدق الله العظيم

سورة يوسف الاية (47)

Dedication

To my father and mother, to my brothers, sisters

To All My Teachers in Plant Protection, Sudan University

of Sciences and Technology, College of Agricultural

Studies

To My Class Mate

TO My spouse

To all friend which help me to produce this work.

Acknowledgement

Firstly, thanks to God for giving me health
and kept me well to finish this work.

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Abstract

This study was conducted in an cultivated Shambat area, Khartoum Bahri, south of college of Agricultural Studies, Sudan University of Science and Technology during (April to May, 2016), to estimate the soil seed bank in this area. The soil data were collected from area mentioned above. The distances between samples were equal (10x10 meters) at a depth of (10 cm) and a diameter (8 cm), and the number of samples (25), and the weight of each sample (1) kg. The samples were taken to plant pathology lab in department of plant protection, college of Agricultural Studies, Sudan University of Science and Technology, then the sample mixed with each other and screened sieve (2) Mesh and fragmentation to (5) parts, and then it was added 250 gm sterilized sand to the soil samples and mixed each other and planted it in plastic bags. The result obtained by this experiment, that the board leaves weeds were dominant in this area in compared to narrow leaves weeds.

ملخص البحث

أجريت هذه الدراسة في منطقة شمبات –الخرطوم بحري جنوب كلية الدراسات الزراعية جامعة السودان للعلم والتكنولوجيا خلال (ابريل-مايو 2016م) لتقدير بنك بذور الحشائش في التربة في هذه المنطقة وتم اخذ العينات علي مسافات متساوية (10×10 متر) علي عمق (10) سم وقطر (8) سم وعدد العينات (25) عينة ووزن كل عينة (1 كيلوجرام) وتم مزج العينات مع بعضها البعض وغربلتها بغربال (2 مش) وتجزئتها الي (5) اجزاء بمعمل امراض النبات قسم وقاية النباتات وزن كل كيس 500 جرام وتمت إضافة 250 جرام من الرمل المعقم الي عينات التربة وتم خلطها مع بعضها البعض وتمت زراعتها في اكياس بلاستيكية واطهرت النتائج المتحصل عليها ان اكثر انواع الحشائش سيادة هي عريضة الاوراق مقارنة مع الحشائش ضيقة الاوراق.

CHAPTER ONE

INTRODUCTION

Plants are essential for human and other animal life on Earth in that they alone capture energy from the sun and convert it into food in the form of their seeds, leaves and roots. Human life is further sustained by the medicines, building materials and fuel that they provide. Plants are central to many ecological processes such as climate regulation (including carbon dioxide absorption), soil fertility and the purification of both water and air.

Plant diversity exists in the form of algae, liverworts, mosses, ferns and seed-bearing species. The latter play the most obvious role in our lives and yet more than 80,000 species of plant (20% of the total) are currently under threat. This threat is largely due to habitat degradation, invasive alien species and over-exploitation; it is likely to be exacerbated by climate change. This threatened diversity is likely to hold the key to solving some of this century's major challenges in the areas of food security, energy availability, water scarcity, and climate change and habitat degradation. Losing it would be catastrophic. (Thompson *et al.*, 1997).

Seed banks offer the opportunity of conserving large amounts of plant diversity, cheaply and effectively at least to the end of this century. This technology has mainly been applied over the past 50 years to conserving the diversity within the relatively few domesticated (crop) species, thereby making it available for varietal

improvement. However, over the past two decades, there has been increasing interest in the use of this technology to conserve non-domesticated (wild) species. Such collections are a resource for habitat restoration and afforestation by enabling species to be put back where lost or in creating new plant communities adapted to future environmental conditions. They are also a huge untapped resource for research and new technology, not least in agriculture and horticulture. Collections contain host species for crop pollinators and close relatives of crops, possessing valuable characteristics that can be transferred to varieties with relative ease. The collections may also be the source of new crop species. Precariously, 80% of our plant-based food intake comes from just 12 crop species - eight grain species and four tuber species. With a relentless increase in the human population and climatic uncertainty, diversification of crop species would seem to be a wise precaution. (Buhler & Maxwell, 1993). The main objectives of this study to investigate and analyzed the soil seed bank of uncultivated area in shambat.

CHAPTER TWO

LITERATURE REVIEW

2.1 The weeds

2.1.1 Definition of weed

Human desires, values, and most importantly economic needs are what drive a plant being defined as a weed. The qualities by which humans define plants as weeds include disturbance, aesthetics, utility or biological characteristics. All of these definitions are the consequence of interactions with humans. Many of these definitions are anthropomorphic, plant qualities as perceived by humans. As such they reveal the plants' relationship to us, and tell us much of how we view nature the nature of weeds and weediness begins by understanding the basis on which these types of plants are defined A plant out of place, or growing where it is not wanted (Blatchley, 1912)

2.1.2 Importance of weeds and reduces in some crops

Several weeds have been put to certain economic uses since ages. *Typha* and *Saccharum* sp used for making ropes and thatch boards. *Cichorium intybus* roots are used for adding flavor to coffee powder. *Amaranthus viridis*, *Chenopodium album* and *Portulaca* sp. used as leafy vegetable. In north India *Saccharum spontaneum* used in breeding programme for developing the noble canes. Incorporation of *Crotalaria*, *Parthenium*, *Calotropis* and *Eichornia* reduced root knot nematode population in the soil as they exhibited nematicidal properties. Hariyali grass (*Cynodon dactylon*) and

Cenchrus ciliaris, *Dichanthium annulatum* *Eclipta alba* weeds of grass land serve as food for animals. People in china and Japan consume *Chlorella pyrenoides* (algae) as protein supplement. Weeds act as alternate host for predators and parasites of insect pests which feed on the weeds. For example *Trichogramma chilonis* feed upon eggs of castor semi looper which damage the castor plants. Some weeds useful to identify the metals (Indicator geobotany) through satellite imageries Eg *Commelina* sp (Copper), *Eichornia crassipes* (Copper Zinc, lead and cadmium in water bodies Several species of weeds *Tephrosia purpurea* and *Croton sparsiflora* in S. India used as green manures, Whereas *Eichornia crassipes* and *Pistia stratiotes* are used for composting. *Argemone mexicana* used for reclamation of alkali soils. NO₂ and SO₂ air pollution determined by wild mustard and chick weed respectively. Aquatic weeds are useful in Paper, pulp and fiber industry. *Chenopodium album* used as mulch to reduce evaporation losses, whereas *Agropyron repens* (quack grass) used to control soil erosion because of its prolific root system. Weeds like *Lantana camera*, *Amaranthus viridis*, *Chenopodium albu*, *Eichhornia crassipes* used for beautification. *Agropyron repense* used for soil conservation, whereas *Dicanthium annulatum* stabilizing field bunds. *Opuntia dellini* used as biological fence, Some weeds have medicinal properties and used to cure snake bite (*Leucas aspera*), gastric troubles (*Calotropis procera*), skin disorders (*Argemone mexicana*) and jaundice (*Phyllanthus nirur*) and *Striga orobanchioides* to control diabetes. In addition to the

above agarbathis (*Cyperus rotundus*), aromatic oils, (*Andropogon sp* & *Simbopogon sp*) are prepared from weeds.

2.1.3 A Crop Fields

2.1.3.1 Reduction in crop yields

The global loss of food production due to weeds was estimated to be 287 million tons per annum accounting for 11.5% of total world food production (Parker and Fryer, 1975). Out of total annual loss of agricultural produce from various pests in India, weeds account for 45%, insects 30%, diseases 20% and other pests 5%. The potential loss caused by weeds in different crops as reported in Indian literatures is summarized, In India; an estimated annual loss of agricultural production is more than Rs.6000 crores due to weeds. If we add the weed losses of the public parks, gardens, other recreation areas, high ways, rail roads, industrial plants, the aquatic problems of lakes, ponds, ditches and tide water areas and public health (hay fever, poisoning), the figures become unbelievable. Such losses due to weeds have not been accounted realistically in any country of the world.

Table 1. Mean potential loss caused due to weeds in some selected crops

Crop	Mean loss
Rice (DSR)	64.0
Wheat	31.6
Maize	48.8
Groundnut	63.6
Soybean	53.0
Mustard	37.7
Linseed	62.7
Sesamum	54.2
Sunflower	32.2
	46.7
Mungbean	46.3
Urdbean	55.4
Chickpea	48.1
Lentil	58.8
Fieldpea	47.1
Cotton	60.4
Sugarcane	34.4
Potato	29.0

Source: Yaduraju (unpublished, 2001)

An environment favorable for crop growth and development is equally favorable for weeds growth. However, the weeds are crop

specific and grow with particular crop as both weeds and crop have same cultural, soil and climatic requirement. If no restriction is imposed they compete with crop plants for nutrients, moisture, light, air, space and other factors in micro-environment, and result loss of crop yield. The loss in crop yield depends upon type of weed flora and its intensity. The extent of yield reduction varies from 15 to 100 per cent. The loss is more acute under moisture stress condition (dryland condition) as weeds comprise a variety of plant types and out of that some are capable of flourish even in moisture stress condition than the crop plants.

2.1.3.2 Reduction in inputs and human efficiency

Besides reducing the crop yields weeds also reduce input and human efficiency. There are many indirect ways through which weeds increase the cost of production and thereby reduce the efficiency of all the inputs, machinery and manpower. For example, in weed infested fields operations like application of fertilizers, insecticides and irrigation become cumbersome. It is difficult to harvest the crops if weeds like wild safflower (*Carthamus oxycantha*), Canada thistle (*Cirsium arvense*), and cocklebur (*Xanthium strumarium*). Cowages (*Mucuna puriens*) annoy the harvest labor by causing itching. Bind weed (*Convolvulus arvensis*) and morning glories (*Ipomoea spp*) bind the crop plants together so well that harvesting of crops becomes time consuming. The weeds at harvest time also bring about excessive wear and tear of farm machines. The admixtures of weed seeds to crop seeds add to the cost of separating weed seeds.

2.1.3.3 Increase protection costs from insects and diseases

Weeds serve as an alternate host to number of pests. During crop season and off season these weeds harbor insect pests and disease organisms of crops and act as an alternate host. Later the specific pests and disease organisms migrate to main crops where they cause higher intensity damage than the weed free crop fields. The pests like carrot weevil, aphids, onion thrips harboured on wild carrot, wild mustard, rag weed and later attack on carrot, cabbage, cauliflower, radish, turnip and onion crops. The pathogen black stem rust harboured on grassy weeds and wild oat and later attack on wheat. Some important insect pests and diseases host weeds and crop affected

2.1.3.4 Reduction in land value

The land heavily infested with perennial weeds, e.g. *Cyperus rotundus*, *Saccharum spontaneum*, *Cirsium arvense*, *Sorghum halepense* has reduced the sale value of land as they incur heavy expenditure to clear or to eradicate.

2.1.3.5 Impair health of men and animals

Some weeds are poisonous to animals and human beings as well. Weeds like *Trianthema spp*, *Astragalus lentiginosus* and *Astragalus pubentissimuer*, *Oxytropis sercea* cause abortion and congenial malformation in sheep and cattle. Similarly *Lupinus spp* is reported to cause crooked calf disease. Fresh green plant of *Phalaris tuberosa* causes death of cattle within hours of eating. Cattle feeding on *Sorghum halepense* during hot months of May and June develop tympani disease due to high concentration of HCN in

this weed. However, with onset of monsoon, the plant makes vigorous growth due to which concentration of HCN comes down below the toxic level.

Some poisonous weeds like Mexican poppy (*Argemone mexicana*) seeds crushed with mustard seeds may lead to blindness and death to people if eaten along with oil. Weeds like *Mimosa pudica*, *Centipeda minima*, and *Datura strumarium* cause wounds, headache, sneezing, giddiness and vomiting. Carrot grass (*Parthenium hysterophorus*) is very harmful for the health of animals and human beings. It contains sesquiterpene lactones (Parthenin, hyenin and ambrosin etc.) which induce severe allergic, dermatitis and other symptoms (Williams, 1984). In cattle due to parthenium contact, there is loss of hair, marked depigmentation of skin, development of lesions in mouth and intestine.

2.1.3.6 Loss in forestry and apiary

Weeds apart from effects on agriculture and horticulture also cause loss to forestry (Seth and Derbal, 1961). Lantana has already become a menace to forests of south (Griffithii, 1941) and in Himachal Pradesh (Chakravarty, 1963).

Poisoning of honey bees foraging on weeds, e.g. *Euphorbia geniculata* is a common occurrence. In flowering weeds compete with crops in attracting bees, interfere with pollination, and finally affect yield of crops.

2.1.3.7 Reduction in Quality of Produce

Contamination of weed seeds reduce the quality of produce in many ways such as wild rice in rice, wild oat in wheat, Argemone in

mustard, wild onion in onion, weedy trash in hay and cotton, parasitic loranthus leaves in tea. The weed seeds with high moisture contents spoil the food grains during storage. Contaminated seeds are poorly accepted by consumers as well as offered lower price.

Presence of weeds like *Cleome viscosa*, *Paederia foetida*, *Brassica spp*, *Oxalis latifolia* eaten by milch animals impart undesirable flavour in milk. The quality of wool or hide is reduced when grazing animals eat fruits of *Achyranthus aspera* and *Xanthium strumarium*.

2.1.3.8 Nutrient depletion

Indian soil is poor in nutrient status and because of this reason productivity of our most of crops is lower as compared to world's developing and developed countries. Further, weeds also remove much more amount of nutrients from soil than the crop plant if left uninterrupted. Work done on major nutrients nitrogen, phosphorus and potassium depletion by scientists in weedy crops.

2.1.4 Importance of soil seed bank

Seed banks may play important roles in conservation of genetic diversity and natural restoration to wetland vegetation as well as to recover endangered plant species. Red data books document extinction and threat of species. The ephemeral species *Coleanthus subtilis* has not been reported for decades in the vegetation cover of any Austrian habitat. Positive experiences controlling *Coleanthus* Localities documented by older herbarium material generally encouraged the idea to compare (old) her bar material of today highly endangered or extinct plant species with seeds of soil samples

collected in corresponding localities. Most of those species, like the ones growing along the shoreline, need unique conditions to survive. Shoreline plants are able to colonize ephemeric semiaquatic environments, i. e. conditions alternating between terrestrial and hydric (Bernhardt & Poschlod 1993). One characteristic of such plants is their capacity to survive in the soil seed bank during unsuitable conditions. Due to the longevity of seeds, those species remain present for decades (Leck 1989, Bernhardt & Poschlod 1993). Therefore, the soil seed bank contains an important portion of the species diversity as well as the genetic diversity of populations. After its rediscovery the population biology of *Coleanthus subtilis* was investigated, especially the life cycle, germination, dormancy, presence in soil seed bank and seed bank dynamics.

2.1.5 Method of Soil Seed Bank

The most common method of seed bank is the seedling emergence technique, where soil samples are extracted and brought back to a greenhouse or lab to be observed under conditions favorable for germination. Under this method, germinating species are removed from the soil as they are identified, and the treatment continues until all seedlings have emerged from the soil. In a review of several methods for estimating seed numbers in the soil, Gross (1990) found that the seedling emergence technique underestimates the seed bank because, under any experimental condition, germination requirements for some species will not be met. However, Gross also noted that this method does provide the most complete listing of

species present in the seed bank. Other methods employed by researchers include direct counts using sieves to separate seeds (Bonis et al.1995), and elutriation, a system that recognizes fine root production from seeds in the soil (Gross 1990). As Gross points out, either of these alternative methods gives better results of actual seed numbers in the soil; however, the methods are severely limited by the necessity of identifying species by seed alone.

In order to development alternative weed systems, it is necessary to have information about the seed bank biology. However, in most agroecosystems little is known about weeds. The determination of seed banks of the soils is very difficult through the techniques that have been used lately, since they demand a lot of work and sometimes destruct seed viability (Buhler & Maxwell, 1993).

According to Roberts (1981), the best way to determine the presence and amount the seed in soil is to observe the seedlings emergence at the site. However, the most frequently used technique involves the determination of the number of seeds placing soil samples for germination in appropriate places, or using physical separation of seeds from the soil particles, based in differences in size and density. When the soil samples are collected the main problems are related to the heterogeneity present in the soil profile. If there is no previous information in relation to the seed distribution, it is recommended to take the soil samples in “W”, like it is normally used for soil chemical analyses (Roberts, 1981). The method of emergence of seedlings is simple and has the advantage of the easy identification

of the species; however, it requires space in the greenhouse or growth chamber and the results can be influenced by seed dormancy (Buhler & Maxwell, 1993). The use of substances that promote the floatation is a good method for seed separation, but these substances can reduce the viability of the seeds. It is, therefore, desirable to reduce the seed exposition to the solution in order to reduce the losses in the seed viability (Buhler & Maxwell, 1993). Several chemical substances have been used for seed separation, mainly cheap salts not highly toxic to. Potassium and sodium carbonate and zinc calcium chlorine are examples. For soils with high clay content it is necessary to use a dispersant, like sodium hexametaphosphate + sodium bicarbonate (Roberts 1981). Buhler & Maxwell (1993) using a solution of potassium carbonate at 10,000 rpm centrifugation recovered about 100% of the seeds of giant foxtail e *Abutilon theophrasti*. The germination of *Chenopodium album*, giant foxtail and *Abutilon theophrasti* was reduced by the exposition to carbonate.

2.1.6 Germination methods

Seed germination depends on both internal and external factors (Bewley and Black 1994). The three most important external (environmental) factors include the proper amounts of water and oxygen and appropriate temperature range too little or too much water, too little oxygen, and temperatures that stay too low may lead to delay or lack of germination. Some seeds from the temperate climate zone may require freezing temperatures for several

consecutive days to scarify .In addition, some seeds have a light requirement for germination (Leck 1989). Most mature seeds have low moisture content, containing only about 5-20% water by weight (Fenner 1985), and must imbibe (absorb) water in order to activate enzymes and initiate metabolism. During the early stages of germination, respiration may be entirely anaerobic (i.e. carried out in the lack of oxygen), but as soon as the seed coat is ruptured, the seed switches to aerobic respiration (Bewley and Black 1994). Too much water may also be a problem since if the seed becomes waterlogged; the amount of oxygen available will be limited and can be inadequate for seedling establishment (Karssen and Hilhorst 1992). In wetlands, seeds must therefore maintain adaptations to overcome the low oxygen levels associated with saturated soil conditions even in favorable conditions some viable seeds will fail to germinate and are said to be dormant.

Common causes of dormancy include physiological immaturity of the embryo and impermeability of the seed coat to water and oxygen (Baskin and Baskin 1989). Seeds with a physiological dormancy will sometimes require a complex series of enzymatic and biochemical changes, referred to as after-ripening, in order to germinate. In temperate climates, after-ripening is triggered by the low temperatures of winter (stratification). The after-ripening requirement, therefore, is seen as an adaptation that delays germination through the stressful winter climate until warmer temperatures when conditions are more conducive to seedling survival (Raven et al. 1992). Seed dormancy may also be induced by

burial in the soil, underdevelopment of the embryo, and chemical inhibition, among other factors (Fenner 1985). These dormancy mechanisms represent adaptations that adjust germination timing for the seed to coincide with favorable environmental conditions,(Bewley and Black 1994).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Site location and collected data

The experiment was conducted in the laboratory of the Pathology, Department of Plant Protection, College of Agricultural Studies, Sudan University of Sciences and Technology. During April- May 2016, For the purpose of estimating reserves weed seeds in the area uncultivated in shambat. The soil samples were collected from the area south of agricultural engineering department, near animal production department in College of Agricultural Studies, Sudan University of Sciences and Technology. Samples were taken from uncultivated area (25 samples) (Fig.1), each sample weighing one kilogram in equal proportions every two meters at a depth of (10 cm) and a diameter of (8 cm) Samples were taken from unplanted area in Shambat. Samples were brought to the laboratory and then mixed with each other and then screened mesh sieve 2 mesh(Fig.2), and then broken down into five bags each bag weighing (500 grams) the seeds were extracted directly washing by passing a stream of water in sieves graded diameters (2 mesh) to remove the impurities Then sample were taken for each sample was placed in plastic bags



Fig. (1) Soil sample



Fig. (2). Sieves graded diameters

3.2 Germination test

Soil samples were put in a container for seeds germination under nursery conditions. Germinated seeds were observed and counted daily up to six weeks to confirm no further seeds germination. Emerged seedlings were

Identified as broad leaved and grasses .The seedlings were removed after counting and identification to facilitate further counting. Number of emerged seedlings was obtained in each depth for each site and season.

3.3 Statistical analysis

.The Statistical analysis by SPSS

CHAPTER FOUR

RESULTS AND DISCUSSION

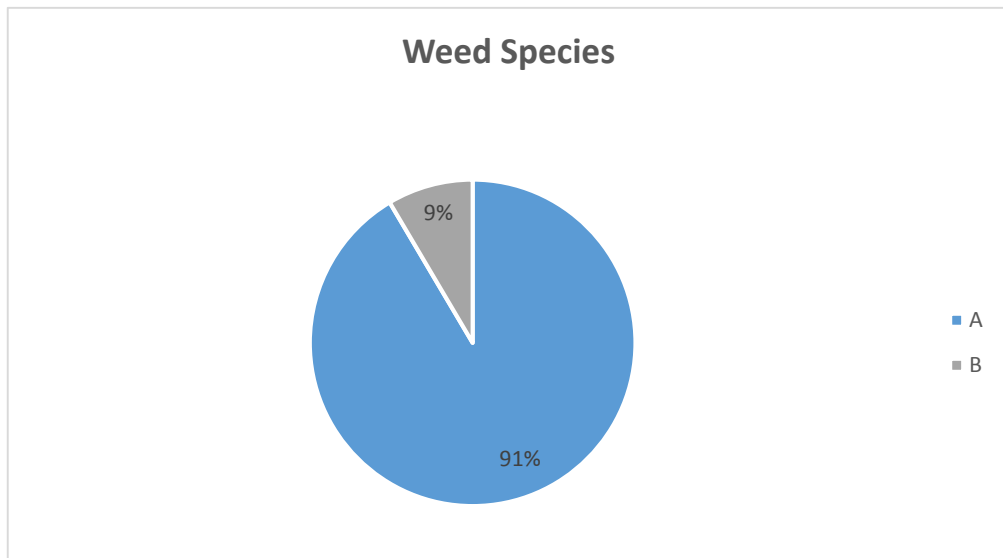
4.1 Species of weed in the study area

The result of the samples that collected from un cultivated area in shambat, were showed considerable different number of total seeds in the area. The highest number of weeds species it has been recorded into the broad leaved *Trianthema portulacastrum* (91.48%) comparing with the number of narrow leaved was obtained in this area *Cynodon dactylon* (8.51%).

This finding is agree with Medalled (2013), he reported that ,soil seed bank consists of both new weed seeds recently shed, and older seeds that have persisted in the soil from previous years. In practice, the soil's weed seed bank also includes the tubers, bulbs, rhizomes, and other vegetative structures through which some of our most serious perennial weeds propagate themselves. Agricultural soils can contain thousands of weed seeds and a dozen or more vegetative weed propagules per square foot.

Table (2) Weed species of uncultivated area shambat

Weeds species		
Scientific name	Weeds (%)	Classification of weed
<i>Trianthema portulacastrum</i>	91.48%	Broad-leaved
<i>Cynodon dactylon</i>	8.51%	Narrow-leaved



A: broad leaved

B: Narrow leaved

Figure (4) Weed species of uncultivated area shambat

Type of seeds	Means	Std. Deviation
Narrow leave	0.8 ^b	1.1
Broad leave	8.6 ^a	5.0
Grand mean	4.7	5.4

Table (3) Mean of seeds number in Shambat area

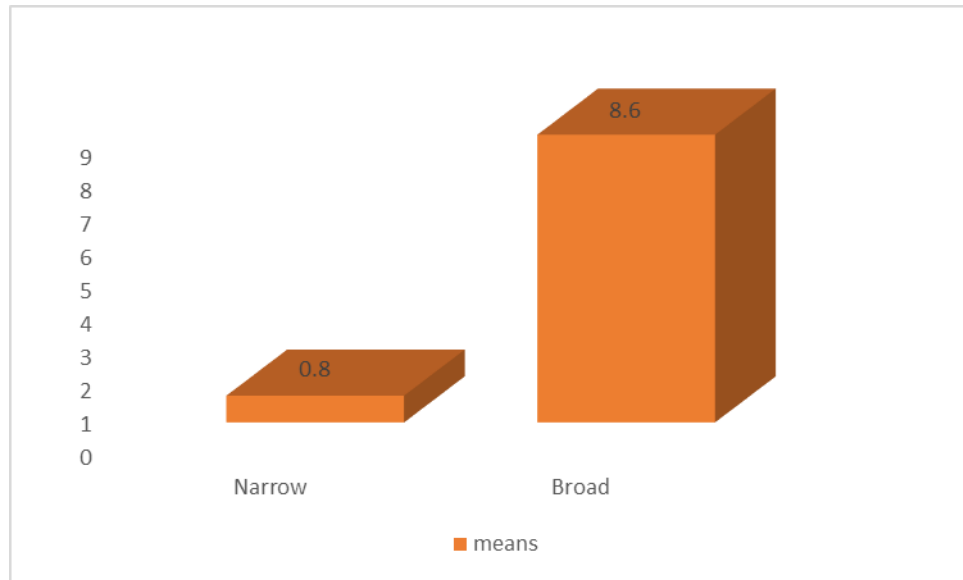


Figure (5) Mean of seeds number in Shambat area

Recommendation

This study is regarded as the best for future studies to show the change in plant cover, seeds population density and to know the flora in shambat area.

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