Original Research Article

Variations of weeds seeds of species belonging to Poaceae on the basis of germination, production and morphological characteristics

ABSTRACT

Aims: Seed characters are very helpful for identification of a large number of species or genera. In many cases, morphological characteristics, germination and production of seeds, can be used to distinguish species and varieties.

Methodology: Study it thoroughly in the laboratory where researchers often observe it by naked eyes, in addition to the reliance on references and researches concerning describing seeds to make the study effective and successful it must be conducted carefully with continual vigilance because of the smallness of some seeds so we use magnifying glass, the optical microscope and pocket lamp to see the different external parts of seeds. Germination of seeds was carried out in laboratory under different temperature (5℃, 10℃,15℃, 20℃, 25℃, 30℃).Production of abundant small seeds is a common adaptation that ensures a high probability of dispersal and re-infestation. Eight characteristics were used to identify eight species of seeds which belong to Poaceae family. The morphological characteristics in which the study was based on are: shape, color, size (length, breadth), solidity, brightness, surface, appendages, weight per 100seeds. Considerable differences were noticed between the various species of weeds seeds

Results: The seeds of the family have great variation in their seed mass and size, considered one of the important factors affecting germination percentage and production rate. Germination percentages ranged from 80% to100%, depending on the species and temperature. The highest germination percentages were reached at alternating temperatures (05℃/30℃). Studies on seed production potential in Bromus sterilis, Bromus rubens, Bromus lanceolatus and Bromus madritensis showed that each plant produces an average of 3700±637, 5000±592, 3000±380 and 4500±426 seeds respectively. Lolium rigidum produces 950±304 seeds /plant whereas Lolium multiflorum produces 900±258 seeds/Plant. One isolated Avena sterilis plant can produce over 235±14 seeds . Thus Avena alba produced 64±15 seeds per plant. Each weeds species shows morphological characteristics different from the plant or other species, these morphological characteristics are not restricted to the external form of the plant only but it can be on level of different other parts of plant like fruit and seed

Conclusion: The study showed that the seeds morphological characteristics can be helpful in identification of species. The ability to produce seeds with big capacity of germination is, most probably, a mechanism by which species of Poaceae as other weed species adapts to new environmental situations and ensures its survival by facilitating the dispersal of its seeds in time and space.

Keywords: Weeds; Seed; Germination; Production; Poaceae; Morphological characters.

1. INTRODUCTION

Weeds are the biggest problem that face agriculture in the world especially cereal crops. For example, total area used to cultivate cereals in Algeria is about 80% of total area cultivated. The loss caused by weeds varies from 20% to 50% depending on the year. The presence of a weed is both linked to an ecological environment (soil, climate) and agronomic practices [1], and edaphic conditions (pH, texture) [2,3] and number of seeds produced [4]. This number is highly variable between species and within a same species [5]. This production of seeds varies depending on the culture in which the weed grows [6]. Weed seeds are difficult to manage because they are small [7], abundant [8], and produce a lot of seed [9].

Seed is a vital genetic source and dispersal unit between successive generation of plants, and it possesses very reliable and constant characters in various groups of seed plants [10].A good identification weeds allows to choose the appropriate herbicide, and the identification of this weed will be easy if its morphological characteristics are well determined [11,12,13] .weeds cause considerable losses over the world as well as the region of study where Fenni [14] evaluated these loss by rates vary between not controlled .Weeds become more dangerous if nor controlled or treated by herbicides, in addition techniques used to till the soil are insufficient or not applied perfectly, the spread and the propagation of weeds will increase [15]. The study of weeds in every respect is very important in addition to study of seeds which play big role in propagating weeds [16,17]. Farron [18] confirmed that gathering and study seeds are very important in malherbology because this latter can help us to identify seeds and know it if it mixed with wheat seeds.

The family Poaceae (nom. alt. Gramineae) forms one of the largest families of flowering plants. It comprises of about 10,000 species and 793 genera. It is by far the most dominant family from an ecological viewpoint [19]. Seed morphological studies have great value and these characters can be individually used as a beneficial tool for the identification of plant species at various levels [20,21]. Identification of weed seeds from overseas countries can be problematic, particularly when diagnostic tools are lacking or incomplete. A well trained seed analyst will usually be able to identify seed to generic level but not always to the species level [22]. Seed Identification can be both a science and an art. Some seed scientists use "seed keys" to identify seeds, others visualization, and most use both depending upon what experience they have in the field and what they are trying to identify. Unfortunately, only the most common agricultural and weed seeds have been described, drawn, or photographed. This makes identifying less common seeds harder [23].

The following research deals with germination, production and the identification of the most morphological characteristics which help to describe seeds in order to know them, so the identification of the species which strength compete with the cultivated plant, the main purpose is attempting to find the effective methods in control to increase production and to try to attain sufficiency.

2. MATERIAL AND METHODS

2.1. Plant material

In this study Seeds of 08 different species of Poaceae (*Lolium rigidum* Graud.,*Lolium multiflorum* Lamk., *Bromus sterilis* L., *Avena alba* Vahl., *Avena sterilis* L., *Bromus lanceolatus* Roth., *Bromus madritensis* L.,*Bromus rubens* L.) were collected from various crop fields located in the region of Setifian high plateau which situated in the north east of Algeria between the two longitude 5°and 6°and between the two latitudes 35°. 40 and 36°.35. After maturation of the seed we collect as many as possible, we put the seed in paper bags to keep it dry and to avoid humidity and climatic factors which lead to germinating these seeds, they were kept in normal condition of laboratory.

2.2. Germination of Seeds

The germination tests were performed with 5 replicates of 20 seeds per Petri dish of 9 cm diameter. Each Petri dish was lined with two layers of filter paper and moistened with distilled water. The criterion of seed germination was visible radical protrusion [24]. The temperature one of the important ecological factor greatly affects the germination of seeds [25]. The seeds placed in Petri dishes were placed at different temperature in a growth chamber germinator (5°C, 10°C, 15°C, 20°C, 25°C, and 30°C) to observe influence of germination of seed with temperature factors. Seeds were observed daily and their average germination and viability were calculated.

2.3. Production of Seeds

Five mature plants per weed species were randomly collected in an area of about 50 x 50 m. Each plant was placed in a paper bag. The plants were subsequently sanded and the mature seed are cleaned manually and counted.

2.4. Morphological characteristics

Seeds morphological discrimination is related to external description of all the characteristics of seed. The study requires taking 05 seeds randomly of each species [13]. Apparent substantial information helps researchers to identify or describe seeds. the work on the identification starts by collecting seeds from fields then study it thoroughly in the laboratory where researchers often observe it by naked eyes, in addition to the reliance on references and researches concerning describing seeds to make the study effective and successful it must be conducted carefully with continual vigilance because of the smallness of some seeds so we use magnifying glass, the optical microscope and pocket lamp to see the different external parts of seeds [26,27].

The morphological characteristics in which the study was based on were used by different researchers for example the characteristics like size, weight ,color and shape were used as suggested by various workers such as Imbert et al. [28].; Irie et al. [29]; Jana and Mukherjee, [30]; Bakhch et al. [11]. As well as other some researchers who bear on other characteristics such as solidity, brightness, surface [31], Appendages [32]. Generally the characteristics were used in this study are the result of the most important characteristics which were used in the different researches of seeds identification.

3. RESULTS AND DISCUSSION

3.1. Seed germination at different temperatures

Figure 1 shows the final germination percentages reached by seeds of the four species at different temperature regimens. Germination percentages ranged from 80% to100%, depending on the species and temperature. The highest germination percentages were reached at alternating temperatures (05℃/30℃).We observed that the four species germinated with percentage of 100% at temperature 10℃ and this percentages lower gradually in the highest temperature mostly for species of Lolium rigidum and Lolium multiflorum . For the two other species Bromus rubens and Bromus sterilis percentages of germination reached 100% at the different temperature (5℃, 10℃,15℃, 20℃, 25℃, 30℃), they are establishing as an important weeds in some areas because of high percent germination of the seeds and similar plants habit to wheat [33].

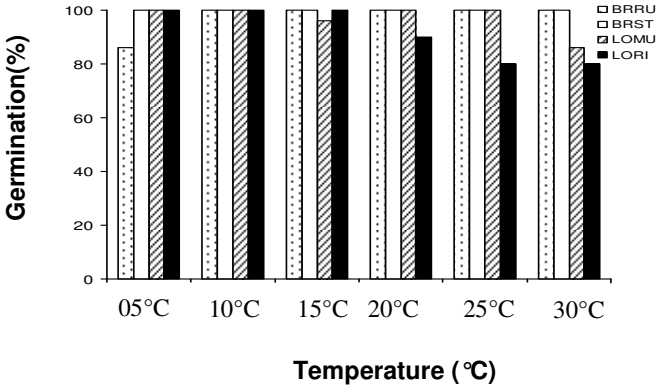

Figure1: Effect of different temperature regimens on the germination of seeds from four species (LORI ‹LOMU ‹BRST ‹BRRU)

The effect of temperature on the germination of seeds from Avena alba, Avena sterilis, Bromus lanceolatus, Bromus madritensis shown in figure 2.Percentages ranged from 0% to 100% depending on temperature. There was a great variability in germination among the species considered. The percentages of germination lower in the highest temperature mostly for Avena alba in 25℃, 30℃ when the percentages reached 0%.We observed that Avena alba and Avena sterilis reached the higher percentages in 5℃ with percentages ranged between 0% to 85%. The effect of temperature on the germination was different in the species of Poaceae family that was confirmed by(Khan et al.2014).Seeds of Poaceae possesses a big capacity of germination and this explains the widespread invasion of these species of Poaceae in the region of study[1].The invasion of the wheat and barley

by the species of Poaceae among the major problems of agriculture in region of study considering the importance of yield losses caused by these species because of great capacity of germination [1].

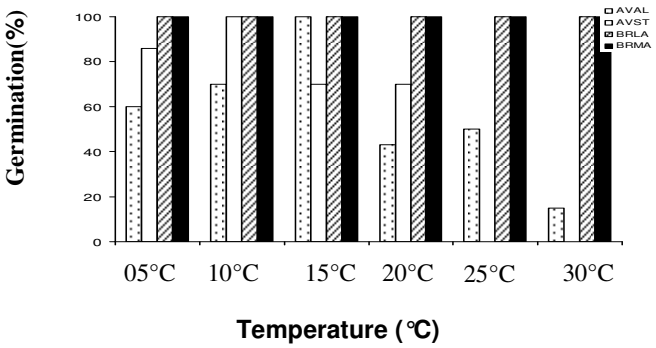

Figure2: Effect of different temperature regimens on the germination of seeds from four species (BRMA ‹BRLA ‹AVST ‹AVAL)

3.2. Seed production

Seed production that is to say the number of seeds produced by plant weed. Knowledge of this number is essential firstly in understanding the dynamics of weed populations and also in selecting long weed control strategies term [3]. The production of seeds varies depending on the culture in which the weed grows. Number of seeds produced per plant is represented in table1.

Seed production was determined for 08 weed species of poaceae. Tanji, [34]stated that weed brome is capable of producing 1000 seed per plant. Studies on seed production potential in Bromus sterilis, Bromus rubens, Bromus lanceolatus and Bromus madritensis showed that each plant produces an average of 3700±637, 5000±592, 3000±380 and 4500±426 seeds respectively, [1]. Lolium rigidum produces 950±304 seeds /plant whereas Lolium multiflorum produces 900±258 seeds/Plant. [3]. One isolated Avena sterilis plant can produce over 235±14 seeds . Thus Avena alba produced 64±15 seeds per plant [35].

Most weed species are prolific seed manufacturers, in some cases producing a more than 5000 seeds/plant (see table 1 for more information). These seeds produced are eventually deposited either onto the soil adjacent to the parent plant or transported to another area where they wait for the adequate conditions to germinate and grow [36].Annual weeds depend on seed production as the sole means of propagation and survival. Production of abundant small seeds is a common adaptation that ensures a high probability of dispersal and re-infestation [37]. Due to high seed production potential combined with dormancy, seed longevity possesses higher advantage as there is a chance of at least for some of them to germinate and grow into new plant a single plant of an annual weed can produce enough seeds in one season to cover an area of one acre [38].

Table 1: Seed production capability (±SD) of Poaceae weeds species.

Weed species	Number of seeds produced per plant	Weed species	Number of seeds produced per plant
Lolium rigidum Graud.	950±304	*Avena alba* Vahl.	64±15
Lolium multiflorum Lamk.	900±258	*Avena sterilis* L.	235±14
Bromus sterilis L.	3700±637	*Bromus lanceolatus* Roth.	3000±380

Bromus rubens L.	5000±592	*Bromus madritensis* L.	4500±426

3.3. Morphological characteristics

In this study the characteristics like, form ,color ,weight…..for identification were used as suggested by various workers in case of cultivated varieties. So such studies help to develop different strategies to control weeds. Species of weeds included in this study are represented in photos (Photo1 to Photo8).

Photo1:Seeds of*Bromus rubens* L.

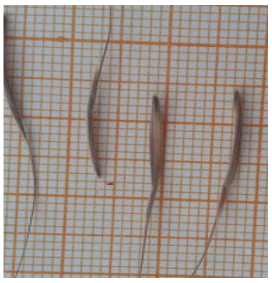

Photo2:Seeds of *Bromus sterilis* L.

Photo3:Seeds of *Lolium multiflorum* Lamk.

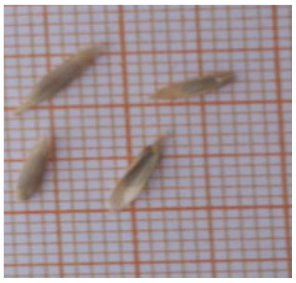

Photo4:Seeds of *Lolium rigidum* raud.

Photo5:Seeds of *Avena alba* Vahl.

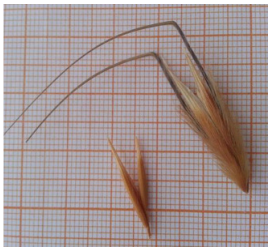

Photo6:Seeds of*Avena sterilis* L.

Photo7:Seeds of *Bromus lanceolatus* Roth.

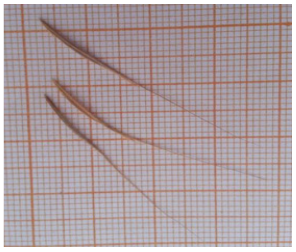

Photo8:Seeds of *Bromus madritensis* L.

In order to identify the different morphological characteristics of seeds specifies of Poaceae, we found that the single character is not enough to distinguish the species because the seeds of more than one species posses same mean value however their standard deviations vary . But the consideration of these characteristics collectively was found unique in this study.

Table 2: Morphological characteristics of species seeds (*Bromus rubens, B.sterilis, Lolium multiflorum, L. rigidum*)

	Species			
Morphological characteristics	***Bromus rubens* L.**	***Bromus sterilis* L.**	***Lolium multiflorum* Lamk.**	***Lolium rigidum* Graud.**
Shape	Linear to obovate	Linear	Obovate to oblong	Obovate to oblong

Color	Yellow dark to brown.	Grayish pale to yellow.	Yellow to grayish	Grayish pale to yellow
Size (mm)	09.65±1.80 01.16±0.12	14.51±1.23 01.13±0.12	06.31±0.62 01.05±0.05	05.80±0.70 01.01±0.12
Surface	Rough	Reticular	Winged	Rough
Solidity	Fragile	Fragile	Ridged	Ridged
Brightness	Bright	Pale	Bright	Pale
Appendages	Awn	Awn	Beak and short awn	Beak and short awn
Weight per 100 seeds (mg)	00.42±0.08	01.35±0.12	00.42±0.02	00.43±0.01

Table 3: Morphological characteristics of species seeds (*Bromus madritensis B.lanceolatus ,Avena sterilis, A. alba)*

	Species			
Morphological characteristics	***Bromus madritensis* L.**	***Bromus lanceolatus* Roth.**	***Avena sterilis* L.**	***Avena alba* Vahl.**
Shape	Linear	Obovate to oblong	Linear to obovate	Obovate to oblong
Color	Grayish pale to brown	Yellow dark with black parts	Yellow to yellow dark	Yellow dark
Size (mm)	15.90±0.87 01.57±0.38	12.95±1.51 03.01±0.59	19.82±5.91 03.02±0.97	13.55±0.93 02.12±0.46
Surface	Reticular	Winged	Hairy	Rough
Solidity	Fragile	Fragile	Fragile	Ridged
Brightness	Pale	Bright	Bright	Bright
Appendages	Awn	Awn	Awn and short beak	Awn and short beak
Weight per 100 seeds (mg)	01.18±0.07	00.47±0.04	15.25±1.33	03.27±0.08

The identifying characters described and used in this publication are found only on the external surface of the seeds. Their usefulness for identification varies. Characters of major importance are color, size and shape of the seed [12,26]. Other characters used in conjunction with these features have limited use. So these characteristics may serve as a convenient method for identification and classification of weeds on the basis of their seed bank available in the soil [39]. However, according to Irié et al. [28] the Variation in seed size is an important character for evolutionary plant ecologists. Variation occurs at several biological levels, from differences between species to within-individual variation. Seed heteromorphism is a special case of within-individual variation in seed size, weight, color and shape (Table 2, Table3). This phenomenon, occurring in more than 200 species of angiosperms, involves the production by single individual plants of seeds of different morphology. In several species, differentiation in morphology is accompanied by a difference in seed size weight, color and shape. Instead of continuous variation in the weight of individual seeds produced by a single plant [27]. Assogbadjo et al., [5] considered that seeds are the main cause of big differences can be shown by species, races, and families because all differences are in the seed which gives birth to the new plant. Each weeds species shows morphological characteristics different from the

plant or other species, these morphological characteristics are not restricted to the external form of the plant only but it can be on level of different other parts of plant like fruit and seed [20].

4. CONCLUSION

Identification of species of poaceae is complicated because of the similarities in many genera. The spread of some being due to the similarity of seed to the crop, similar growth habit and morphological description of seed. Seeds morphological description is related to external description of seed, weeds seeds show very big differences as well as seeds of the same species which also can show many morphological differences because of many factors, especially, the degree of maturity. Climatic changes from one year to another, some botanical diseases and environmental differences ….and many other factors affect change difference of morphological characteristics (form, color, size…).

The results of germination study show that the Seeds of Poaceae possesses a big capacity of germination and this explains the widespread invasion of these species of Poaceae in the region of study. Germination percentages of the most species ranged from 80% to100%, depending on the species and temperature. For the four species, Bromus rubens , Bromus sterilis, Bromus lanceolatus and Bromus madritensis, percentages of germination reached 100% at the different temperature (5℃, 10℃,15℃, 20℃, 25℃, 30℃). The ability to produce seeds with different degrees of dormancy is, most probably, a mechanism by which species of Poaceae as other weed species adapts to new environmental situations and ensures its survival by facilitating the dispersal of its seeds in time and space. Several studies have focused on the association of morphological differentiation with differences in germination rate and/or dispersal capacity, but consequences of differences in seed size, weight ,color, shape, solidity, brightness, surface, and appendages for growth and reproduction have been poorly studied.

The developmental variations of seed germination, production and morphology are worth taking into account, not only because they give us a better comprehension of seed characters but also for preparing an identification key.

REFERENCES

1. Fenni M. Study of weeds of winter cereals Constantine high plains, ecology, dynamics, phenology and biology of brome, Doc. Thesis, Biol. Inst; 2003.

2. Gardarin A, Dürr C, Colbach N. Prediction of germination rates of weed species: Relationships between germination speed parameters and species traits. Ecological Modelling. 2011 ; 222: 626-636.

3. Lebazda R, Fenni M, Hani M, Boukhebti H. A survey of weed seed production in vegetable crops of Setifian high plateau. Advances in Environmental Biology. 2016;10: 131-136.

4. Debaeke Ph. . Dynamique de quelques dicotylédones adventices en culture de céréales, I. Relations flore levée, stock semencier, Weed Res. 1988 ;28: 251-257.Frensh

5. Assogbadjo A , Sinsin B. Van Damme P. Caractères morphologiques et production des capsules de boabab (Adansonia digitata L.) au Bénin .E.D.P .Sciences,Fruits. 2005 ;60:327-340. French.

6.Loudyi MC, Godron M , El Khyari D. Influence of environmental variables on the distribution of weeds in crops of Sais (central Morocco), Weed Research. 1995; 35: 225-240.

7. Bell K, Vidal N, Symons S. Visual Identification of Small Oilseeds and Weed Seed Contaminants ,Grain Biology Bulletin. 2000; 3:1-39

8.Robert L , Zimdahl R. Fundamentals of Weed Science, Academic Press is an imprint of Elsevier . 2007; 1: 80-83.

9. Blackshaw K N , Harker RE. Scentless chamomile (Matricaria perforata) growth, development and seed production, Weed Sc. 1997;45: 701-705.

10. Rubina A, Durdana K, Qaiser M. Seed morphological studies on some monocot families (excluding gramineae) and their phylogenetic implications. Pak. J. Bot. 2014;46: 1309-1324.

11. Bakhch A, Dasti AA, Munir A, Khaliq I, Aminudin M, Akhtar MS. Studies on shape ,size and weight of certain weed seeds buried in the soil seed bank, Pak. J.Weed Sci. Res. 2006 ;12: 79-82.

12. Groth D. Morphological characterization of four weed seeds of Ipomoea L. (Convolvulaceae). Revista Brasileria de Sementes. 1998; 20:75 -79.

13. Hani M, Fenni M , Bouharati S . Fuzzy Inference System for Identification of Cereals Weeds Seeds. Journal of Environmental Science and Engineering. 2011; 5: 1337-1342.

14. Fenni M. Choix de l'outil de travail du sol et de la date du labour .Lab.V.R.B.Dep.D'agronomie ,Con.Inte.Mèc.Agri. 2005 ; 2 :123-127.

15. Casals M L, Hacquet J, Deneufbourg F, Chauvel B , Citron G. Integrated weed management in Integrated weed management in alfalfa seed production in West of France, seed production in West of France, Innovations Ag. 2014; 35: 19-26.

16. Granitto P M, Navone H D, Verdes P F , Ceccatto H A. Automatic identification of weed seeds by color image processing. Ceccatto I. F. R. 2000;21:1-8.

17.Tanji A. Inter- and intraspecific competition of ripgut brome (Bromus rigidus) and wheat (Triticum aestivum) cultivars. XVIIIème Coll. Inter. Biol .Ecol.et Syst. Des mauvaises herbes. 2000;1 :1-8.

18. Farron C. L'intérêt d'une collection de graines : son utilisation au services de malhrbologie .Rec.Agr. 1984 ; 23:167-170.

19. Aniszewski T, Mervi K.H, Leinonen AJ.Seed number, seed size and seed diversity in Washington Lupin (Lupinus polyphyllusLindl.). Ann. Bot. 2001; 87: 77–82

20. Djé Y, Heuertz M, Ater M, Lefebvre C, Yekemans X.Evaluation de la diversité morphologique des traditionnelles de sorgho du Nord-ouest du Maroc. Bio.Agr.Sos. Env. 2006 ; 12 :1-6.

21. James T K, Champion P D, Dowsett C A , McNeill M R , Houliston G J. Identification of weed seeds in soil samples intercepted at the New Zealand border. Biosecurity. Plant Protection. 2014; 67:26-33.

22.Granitto P M, Hugo D, Navone, Verdes P F , Ceccatto H A. Weed seeds identification by machine vision, Elsevier B.V. 2002; 33: 91-103.

23.Lonchamp JP, Mathey P. Sementia : Logiciel d'identification des semences de mauvaises herbes . Lab .Mal. Agr.I.N.R.A.Dijon . 1998 ; 17:91-98.

24.Mehmeti A, Demaj A , Waldhardt R. Germination traits of three weed species in Kosovo. Web Ecol. 2010;10: 15–22.

25.Perez-Garcia F, Iriondo JM , Martinez-Laborde JB. Germination behavior in seeds of Diplotaxis erucoides and D. virgate. Weed Res. 1995;35:495-502.

26. Granitto PM, Garralda PA, Verdes PF and Ceccatto HA. 2003. Boosting classifiers for weed seeds identification, J.C.S.et T. 13:34-39.

27. Granitto P M, Verdes PF , Ceccatto H A. Large- scale investigation of weed seed identification by machine vision. Elsevier B.V. 2004;47:15-24.

28. Imbert E, Escarré J , Lepart J. Seed heteromorphism in Crepis sancta (Asteraceae): performance of two morphs in different environments. Oikos. 1997;79: 325-332.

29. Irié A, Zoro B, Kévin KK, Djé Y. Caractérisation botanique et agronomique de trios espèces de cucurbits consommés en sauce en Afrique de l'Ouest :Citrullus sp.Cucumeropsis mannii Naudin et Lagenaria siceraria (Molina) Standl. Biotechnol.Agron.Soc.Environ. 2003 ;7:189-199. French.

30.Jana B, Bar R , Mukherjee S. Structural variations of cypselas of some taxa of the tribe Calenduleae (Asteraceae), on the basis of morphological observation. International J. Res. in Bio Sciences. 2013;2:53-58.

31. Hani M, Fenni M, Lebazda R. Identification of weed seeds of some species belong to Asteraceae in Setifian high plateau. Advances in Environmental Biology. 2017. 11(2) : 60-65

32.Parkinson H J, Mangoldand M. F. Weed Seedling Identification . Montana State University Extension, 2013.

33. Khalid S, Shad R A. Importance of structure and shape in the spread and adaptability of weed seed. Pakistan J. Agrico.Res. 1990 ;11:111-132.

34.Tanji A. Production de semences par les adventices dans les champs de blé et d'orge en milieu semi-aride marocain. Al Awamia. 1999 ; 99: 09-18.Frensh

35.Leguizamón E S, Robert A.Seed production by an arable weed community. Weed Research. 1982; 22: 35-39.

36. Burnside O C, Moomaw R S, Roeth F W, Wicks G A an,d R. G. Wilson. Weed seed demise in soil in weed-free corn (Zea mays) production across Nebraska. Weed Science, 1986;34:248-251.

37. Lutman P J W. Estimation of seed production by Stellaria media, Sinapis arvensis, Tripleurospermum inodorum in arable crops. Weed Research. 2002;42: 359-369.

38. Shivakumar KV, Devendra R, Muniswamappa MV, Halesh G K Mahadevamurthy M. Weed seed production potentials in Bidens pilosa L. in plantation crops in hill zone of Karnataka, International Journal of Research in Applied.(IJRANSS). 2014; 2: 11-18.

39. Gu X M , Kianian S F, Foley M E . Seed dormancy imposed by covering tissues interrelates to shattering and morphological characteristics in weedy rice . Crop Sc.So.America. 2005;36 :1-7.