**Research Article** **AJAR (2017), 2:7**

**American Journal of Agricultural Research (ISSN:2475-2002)**

# Seed viability and emergence depths of *Ageratum conyzoides* L. (Asteraceae)

**Ipou Ipou Joseph[1*], Gué Arsène[1], Touré Awa[1]& Kouakou Nanan Joseph[1]**

[1]Université Félix Houphouët Boigny, Laboratory of Botany, UFR Biosciences, 22 BP 582 Abidjan 22, Ivory Coast.

## ABSTRACT

*Ageratum conyzoides* is a major weed among food crops in Ivory Coast. The viability of its seeds and the depth of emergence of its seedlings were studied in order to understand its distribution and to develop effective management strategies. Generally, less than 50% of the seed of this plant remains viable after one year of soil burial. However, the viable seed rates of this species vary according to depths of burial. The lowest viable seed rates were noted at burial depths of 0 cm and 0.5 cm (5.25% and 8.5% viable seeds, respectively), intermediate rates were at burial depths of 2.5 cm and 10 cm (28% and 26.5% viable seeds, respectively) and the highest rates were at burial depths of 5 cm (43% viable seeds). The highest rates of seedlings of *Ageratum conyzoides* (75%) were obtained at soil surface. These results indicate that the lifetime of seeds of *Ageratum conyzoides* depends on their position in the soil. Seed stocks on soil surface are ephemeral while those depths between 2.5 and 10 cm from soil surface may be persistent. For this, after all tillage to a depth of between 2.5 cm and 10 cm from soil surface, regeneration of *Ageratum conyzoides* must be prevented by destroying raised plants before they reach fruiting.

**Keywords:** *Ageratum conyzoides*, Viability of seeds, Seedling emergence

***Correspondence to Author:**
Ipou Ipou Joseph
Université Félix Houphouët Boigny, Laboratory of Botany, UFR Biosciences, E-mail: ipoujoseph@yahoo.fr, Tel: (225) 07546039

**How to cite this article:**
Ipou Ipou Joseph et al.,. Seed viability and emergence depths of Ageratum conyzoides L. (Asteraceae). American Journal of Agricultural Research, 2017,2:7.

eSciencePublisher
eSciPub LLC, Houston, TX USA.
Website: http://escipub.com/

## Introduction

*Ageratum conyzoides* or billy goat grass is one of the major weeds of food crops found in all agro-climatic zones of Ivory Coast [1, 2, 3]. Because of its abundance, it is a most harmful species which is able to colonize virtually all environments and which adapts very well to plots of food crops. This species can affect indigenous crops and plants by releasing a number of phenolic acids and volatile oils from its leaves and flowers [4]. Under environmental stress, it releases certain secondary metabolites which give it a particular selection advantage compared to other plants.

On cultivated plots, *Ageratum conyzoides* can reduce yields of maize, rice and other important crops [5]. To the best of our knowledge, no specific data exist regarding production losses caused by this weed, but these losses do depend on the degree of weed infestation [5]. Rice production is negatively associated with *Ageratum conyzoides* density [6].

*Ageratum conyzoides* is an annual plant with a very large invasive potential due to its seed production capacity of 40,000 seeds / plant [7]. The survival of its seeds is therefore necessary for its continued existence in agrosystems. Indeed, the development of a persistent seed stock is a characteristic of problematic weeds and a sign that the plant has been naturalized in the habitat [8]. Persistent seed stocks are those in which seeds can survive for up to two years or more [8]. They are more of a concern for farmers because their management or eradication is difficult. Ephemeral seed stocks contain seeds that germinate and reduce soil reserves in a time period of one year [8].

Establishing an effective management program for billy goat grass requires an understanding of the ability of the seed to survive in the seed bank, as well as the conditions for their germination and emergence. Unfortunately, to the best of our knowledge, there is no study on the ecology of seeds of this species. The aim of the present study was to examine the viability of seeds of *Ageratum conyzoides* after one year of burial in soil and to assess the influence of seeding depth on emergence of seedlings of this species.

## Materials and methods

### Seed collection

Seeds of *Ageratum conyzoides* were harvested at Dadéguhé, 20 km from Issia (6° 29 ‘N latitude and 6°35’ W longitude), in the Center West of Ivory Coast. The seeds were collected at the foot of the species. At maturity, the fruit of this species has a black achen with a pappus of five white scales.

### Impact of landfill duration on seed viability

To study the viability of *Ageratum conyzoides* seeds in soil, mature seeds were used that were harvested from plants. These seeds were buried in plastic pots (dimensions: 9.5 cm in diameter and 25 cm in depth), filled with sandy clay soil that was taken from Issia during April 2013. The seeds were removed in early April 2014.

Finely perforated nylon sachets containing 100 *Ageratum conyzoides* seeds each were placed at depths of 0 cm (soil surface), 2.5 cm, 5 cm and 10 cm from the soil surface in plastic pots filled with Issia sandy clay soil. The bags on the ground surface were covered with a metal screen of dimensions (15 cm x 30 cm) with mesh of 6 mm x 6 mm to prevent strong winds that can carry away sachets and as protection against small predatory animals. The experiment lasted one year and the date of seed withdrawal (April) corresponds to the sowing date at the start of the first cropping cycle in the forest zone of Ivory Coast.

To remove the sachets from the pots, soil around the sachets was carefully removed in order to maintain their integrity. Soil and debris were then removed from the sachet and the seeds were removed. The seeds were then sorted and stored according to their physiological conditions. Thus, seeds which remain firm when pressed with a small clamp are considered viable [9]. Seeds with an emerged radicle are considered lost because they can no longer be part of the seed stock. The remaining seeds are considered non-viable. In this study, the seeds that were missing from sachets that were removed from the soil were also considered lost because each sachet contained 100 seeds at the time of emergence.

### Influence of sowing depths of seeds on seedling emergence

The experiment was carried out in situ in Dadéguhé. Mature seeds that were harvested from the plants were used to study depths of seedlings emergence of *Ageratum conyzoides*. Seedling surveys were conducted at depths of 0 cm, 0.5 cm, 2.5 cm, 5 cm and 10 cm. Four replicates of 100 seeds were used for each seeding depth. The tests were carried out in plastic pots (dimensions: 9.5 cm diameter and 25 cm depth) filled with sandy-clay soils taken from Dadéguhé. The experimental method used to observe the influence of seeding depths on seedling emergence is the completely random scheme.

Water was applied to the pots once a day (in the morning) during the observation period to allow normal emergence of seedlings. The counting of seedlings was undertaken on a daily basis for two months from the date of sowing.

### Analysis of data

The rate of each seed category (lost, non-viable or viable) is obtained by plotting the number of seeds in the seed number, over the number of seeds originally planted, multiplied by 100. The formula for calculations is the following:

$$Tc = (Nc \;/\; Ngi) \times 100$$

where Tc is rate of the seed category considered, Nc is number of seeds of a given category (lost, non-viable or viable) and Ngi is number of seeds initially buried in the soil. Seed-borne, non-viable and viable seed rates were analyzed for variance (ANOVA). For each of these studied parameters, when the analysis of variance shows a significant difference, the Duncan test at the threshold of 0.05 is performed to separate the means.

ANOVA was also used to analyze the influence of seed depth on seedlings emergence. Mean separation was also performed using the Duncan test at the threshold of 0.05.

## Results

### Lost, non-viable and viable seeds of *Ageratum conyzoides*

The average seed losses for *Ageratum conyzoides* were 29.50 ± 3.42%; 20.50 ± 4.12%; 29.25 ± 4.27%; 19.25 ± 4.35% and 27.50 ± 4.20 respectively for burial depths 0 cm, 0.5 cm, 2.5 cm, 5 cm and 10 cm. ANOVA detected a significant difference between the different depths of seeding ($P$ = 0.005). The Duncan test at the 0.05 threshold shows two homogeneous groups of burial depths (Figure 1). There are, on the one side, depths of 0.5 and 5 cm with smallest percentages of lost seeds, and on the other side the depths 0; 2.5 and 10 cm with highest rates of seed loss.

One year after burying of seeds of *Ageratum conyzoides*, average rates of non-viable seeds were 64.75 ± 3.78%; 71.50 ± 3.11%; 37.75 ± 2.22% and 43.5 ± 3.11% respectively for burial depths 0 cm, 0.5 cm, 5 cm and 10 cm. Analysis of variance shows a significant difference between the different burial depths ($P$ = 0.000). The Duncan test at the 0.05 threshold shows four homogeneous groups of seed burial depths (Figure 2).

Average viable seed rates of *Ageratum conyzoides*, one year after burying, are 5.25 ± 2.22%; 8.50 ± 1.29%; 28.00 ± 4.97%; 43.00 ± 2.45% and 26.50 ± 2.89% respectively for burial depths 0 cm, 0.5 cm, 2.5 cm, 5 cm and 10 cm. Analysis of variance shows a significant difference between these burial depths ($P$ = 0.000). The Duncan test at the 0.05 threshold detects three homogeneous groups of burial depths (Figure 3). First, there are depths of burial 0 cm and 0.5 cm which shows the smallest percentages of viable seeds. Second, there are depths of burial 10 cm and 2.5 cm with intermediate percentages of viable seeds. Third, there is depth of burial 5 cm which gives the highest percentage of viable seeds.

### Depths of seedlings emergence

The average rates of seedlings emergence of *Ageratum conyzoides* with respect to seed depths of 0 cm, 0.5 cm, 2.5 cm, 5 cm and 10 cm are 75 ± 8.4%; 29 ± 4.97%; 2.25 ± 1.71%; 0% and 0%, respectively. Analysis of the variance showed a significant difference between seed-

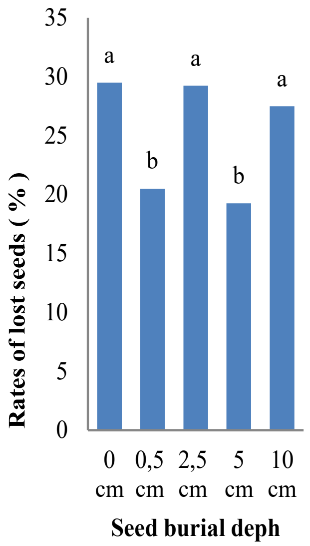


Figure 1. Rates of lost seeds of *Ageratum conyzoides* vs. burial depth

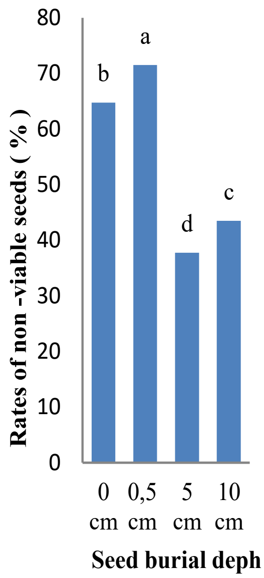


Figure 2. Rates of non-viable seeds of *Ageratum conyzoides* vs. burial depth

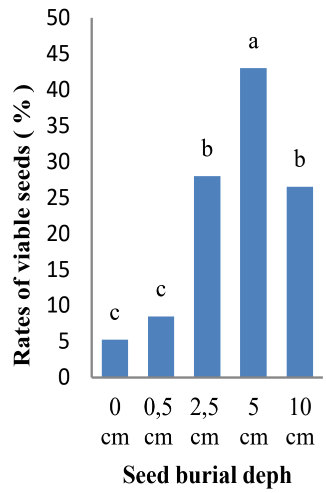


Figure 3. Rates of viable seeds of *Ageratum conyzoides* vs. burial depth

**Table I.** Rate of seedlings emergence of *Ageratum conyzoides*

| | | | | | |
|---|---|---|---|---|---|
| | | Rate of seedlings emergence (%) | | | |
| | | Depths of sown seeds (cm) | | | |
| | 0 | 0,5 | 2,5 | 5 | 10 |
| | 75,00 ± 8,40 [a] | 29,00 ± 4,97 [b] | 2,25 ± 1,75 [c] | 0 [c] | 0 [c] |

Means that do not have the same letters are significantly different (*P*< 0.05) ling depths for emergence of *Ageratum conyzoides* (*P* = 0.000). The Duncan test at the 0.05 threshold revealed three homogeneous groups of seed depths (Table I). Group one includes depths of 2.5 cm, 5 cm and 10 cm which allow a zero or very low percentage of emergence of *Ageratum conyzoides* seedlings. Group two consists of depth 0.5 cm. Group three, which only includes depth 0 cm, gives the highest seedlings emergence rates of *Ageratum conyzoides*.

## Discussion

One year after seeding of seeds of *Ageratum conyzoides*, rates for non-viable seeds are highest. Then, in descending order, are rates for lost seeds and viable seeds. This result can be explained by the fact that a large part of the seeds of *Ageratum conyzoides* germinate immediately after their dispersal [10]. Consequently, when these seeds do not encounter favorable germination conditions at some stage after their production, they lose their viability.

However, viable seed rates of *Ageratum conyzoides* vary according to seed burial depths. Depth of burial 5 cm shows the highest viable seed rates (43%), depths 2.5 cm and 10 cm, show intermediate viable seed rates (between 26.5 and 28%) and depths 0 and 0.5 show lowest viable seed rates (between 5.25 and 8.50%). Low levels of viable seeds found at 0 and 0.5 cm would be due to the fact that seeds buried at these depths were subjected to ambient temperature. Indeed, small seeds (about 0.2 mg) such as those of *Ageratum conyzoides* lose their viability after one year of storage at room temperature [11].

Seedlings emergence rates of the most important *Ageratum conyzoides* seedlings were observed at soil surface. This result can also be explained due to the small size of seeds of this plant. Indeed, small seeds such as *Ageratum conyzoides* do not have sufficient reserves to ensure heterotrophic growth of seedlings before they are established at soil surface, hence their emergence is only possible at very low depths, at the level of the first few centimeters [12]. Further, there are unfavorable germination conditions (lack of water and oxygen) at depth [13].

## Conclusion

In general, less than 50% of seeds of *Ageratum conyzoides* remained viable one year after being buried. However, this result varied according to burial depths of seeds. Depths 0 and 0.5 cm showed lowest viable seed rates with values of 5.25% and 8.5%, respectively. Depths 2.5 cm and 10 cm gave intermediate levels of viable seed rates (28% and 26.5% of viable seeds, respectively). Highest rates of viable seeds (43%) were observed at depth of burial of 5 cm. Highest growths of seedlings of *Ageratum conyzoides* (75%) were observed at soil surface. At 0.5 cm below soil surface, an intermediate seedling rate is estimated to be 29%. Seeding depths of 2.5 cm, 5 cm and 10 cm show lowest rates of the seedling emergence. Results of this study indicate that persistence of seeds of *Ageratum conyzoides* depends on their position in the soil. Seed stocks at soil surface are ephemeral while those between 2.5 and 10 cm below soil surface may be persistent. Further, after all tillage to a depth of between 2.5 cm and 10 cm below soil surface, regeneration of *Ageratum conyzoides* must be effectively prevented by destroying raised plants before they reach fruiting stage.

## References

1. Ipou Ipou J. 2005. Biologie et écologie de Euphorbia heterophylla L. (Euphorbiaceae) en culture cotonnière, au Nord de la Côte d'Ivoire. Thèse de doctorat de l'Université de Cocody, Abidjan, Côte d'Ivoire, 168 p.

2. Touré A., 2009. Dynamique d'infestation de la forêt classée de Sanaimbo dans la sous-préfecture de Tiémélékro (Côte d'Ivoire) par les adventices des agro-écosystèmes environnants et leurs utilisations par les populations riveraines. Thèse de Doctorat de l'Université de Cocody, Abidjan, Côte d'Ivoire, 188 p.

3. Mangara A., N'Da A. A. A., Traoré K., Kehe M., Soro K., Touré Mâ., 2010. Étude phytoécologique des adventices en cultures d'ananas (Ananas comosus (L.) Merr.) dans les localités de Bonoua et N'douci en Basse Côte d'Ivoire. Journal of Applied Biosciences, 36: 2367- 2382.

4. Kong C., Hu F. & Xu X., 2002. Allelopathic potential and chemical constituents of volatile oil from Ageratum conyzoides under stress. Journal of Chemical Ecology, 28: 1173–1182

5. Kohli K. R., Batish R. D., Singh P. H. & Dogra S. K., 2006. Status invasiveness and environmental threats of three tropical American invasive weeds (Parthenium hysterophorus L., Ageratum conyzoi-

des L., Lantana camara L.) in India. Biological Invasions 8: 1501–1510.

6. Roder W., Keobulapha B., Phengchanh S., Prot JC. & Matias D., 1998. Effect of residue management and fallow length onweeds and rice yield. Weed Research 38: 167–174.

7. Holm, L. G., Plucknett, D.L., Pancho, J.V. & Herberger, J.P. 1977. The World's Worst Weeds, Distribution and Biology. In University Press of Hawaii, Honolulu (USA), pp.139 -145.

8. Kegode O. G., Nazre G. & Christoffers J. M., 2010. Germination Ecology of Beennial Wormwood (Artemisia biennis) and Landleaf Sage (Salvia reflexa) Seeds. Weed Science, 58 : 61-66.

9. Forcella F. R. G., Wilson K. A., Renner J., Dekker R. G., Harvey D. A., Alm D. D., Buhler, Cardina J., 1992. Weed seed banks of the US Corn Belt: magnitude, variation, emergence, and application. Weed Science, 40: 636 – 644.

10. Le Bourgeois T. &Merlier H., 1995. Adventrop : les adventices d'Afrique soudano-sahélienne. Edit. CIRAD-CA ; 640 p.

11. Nakamura I. & Hossain A. M., 2009. Factors affecting the seedling emergence of redflowerragleaf (Crassocephalum crepidiooides). Weed Biology and Management 9: 315- 322.

12. Gardarin A., 2008. Modélisation des effets des systèmes de culture sur la levée des adventices à partir de relations fonctionnelles utilisant les traits des espèces. Thèse de Doctorat de l'Université de BOURGOGNE, France, 280p.

13. Ipou Ipou J., Marnotte P., Aman Kadio G., Aké S. & Touré Y., 2004. Influence de quelques facteurs environnementaux sur la germination d'Euphorbia heterophylla L. (Euphorbiaceae). Tropicultura, 22 : 4 : 176 – 179.