INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 23, No. 6, p. 146-155, 2023

RESEARCH PAPER OPEN ACCESS

Influence of amendment type and re-cutting on biomass production and germination capacity of *Artemisia annua* L. in Burkina Faso

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Key words: *Artemisia annua*, Biomass, Fertilizers, Pruning

http://dx.doi.org/10.12692/ijb/23.6.146-155 Article published on December 08, 2023

Abstract

Artemisia annua L. is a plant containing artemisinin in its leaves, recommended by the world health organization (WHO) for the treatment of malaria through Artemisinin-based Combination Therapy (ACT). This study was carried out to develop an efficient technique for producing aerial biomass and seeds with high germination capacity of the species. A factorial block design was used, with three replications and two factors, namely organic fertilizer with three modalities and the level of pruning, also with three levels. The results showed a significant difference ($p<0.0001$) between treatments and biomass production. Plants fertilized with compost and harvested at 20 cm from the crown produced more seed biomass and more above-ground dry biomass, with 12.690±0.66 grams per individual and 49.333±0.87 grams per individual respectively. The unfertilized, uncut control (28.086±0.64 grams) and the compost (28.255±1.47 grams) and Fertile Soil (9.689±1.12 grams) treatments cut at 10 cm from the crown did not produce good above-ground biomass. The results also showed that seeds from plants re-sowed at 10 cm from the soil and fertilized with compost germinated significantly ($p<0.0001$) more (79.33±1%) than non-re-seeded, non-fertilized control plants (55.33±3%). In summary, we can conclude that organic fertilization with compost and re-coring of plants at 10 cm and 20 cm from the crown respectively improved the germinative power of the seeds produced and above-ground biomass.

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Introduction

Malaria is a major health concern in Burkina Faso. The entire population of Burkina Faso is exposed to malaria throughout the whole year. According to the WHO, more than 12 million cases of malaria and over 29,000 malaria-related deaths occur every year (Yao *et al.*, 2022). A growing body of scientific research and action has been undertaken to combat malaria, and over the last decade has helped to reduce the number of malaria cases, but the number of cases and the mortality rate remain high (WHO, 2021). Artemisia (*Artemisia annua* L.), a plant that has been used in traditional Chinese medicine for over two thousand years, is believed to be a natural, low-cost remedy for malaria for low-income populations. Numerous international studies, particularly in Africa, confirm this. Indeed, according to Blanc and *al.* 2008, given the efficiency and the very low toxicity of artemisinin in the treatment of malaria, the WHO recommended its use in 2001 to fight against this disease through ACT (*Artemisinin-based Combination Therapy*). According to the same source, China, the leading producer of artemisinin, markets it at a very high price. This has prompted some countries with limited resources to set up their own *Artemisia annua* production facilities. Thus, first Vietnam and then East Africa implemented the production of this plant. This study falls within this frame with the aim of providing Burkina Faso with its own *Artemisia annua* production chain. Artemisinin, the active ingredient against plasmodium, is mainly present in the plant's leaves. In fact, artemisinin is 89% concentrated in the leaves just before flowering (Laughlin, 2002). It is sometimes found in the seed, probably due to the presence of floral residues (Ferreira and Janick, 1996). The amount of artemisinin present in *Artemisia annua* leaves depends on the soil type and rainfall in the growing area. Other authors reported that a nitrogen deficit induces a significant drop in leaf artemisinin content (De Magalhães *et al.*, 1996). Our study was carried out in the wet season, since according to Giblain *et al.*, 2006, in a tropical climate, the rainy season is the most favourable for plant development, with higher artemisinin yields. There is no universal technical data sheet for growing *Artemisia annua*. Only pilot tests can provide a better understanding of the plant's response (Blanc *et al.*, 2008). The pilot tests proposed in this study are fertilization and pruning. Re-pruning produces a new shoot that is stronger than a seedling or plantation, and produces abundant offshoots. The specific aims of the present study are (i) to evaluate the effects of two fertilizers and two levels of pruning on the germinative capacity of seeds produced and plant growth, (ii) to assess the influence of varying pruning levels and fertilizer types on *Artemisia annua* leaf biomass production in Burkina Faso, and (iii) to determine the type of fertilizer and pruning level that are optimum for good quality *Artemisia annua* seed and leaf production.

Materials and methods

The experimental study site is located at 45 km away from Ouagadougou in the south-central region (Ipelcé) of the Bazèga province. The isohyets varied between 700 mm in the north and 1000 mm in the south. The province is part of the northern Sudanian sector described by Fontès and Guinko, 1995. The geographical coordinates of the experimental site are latitude: 11.96, longitude: -1.545 11° 57′ 36″ North, 1° 32′ 42″ West, an altitude of 333 m.

Plant material

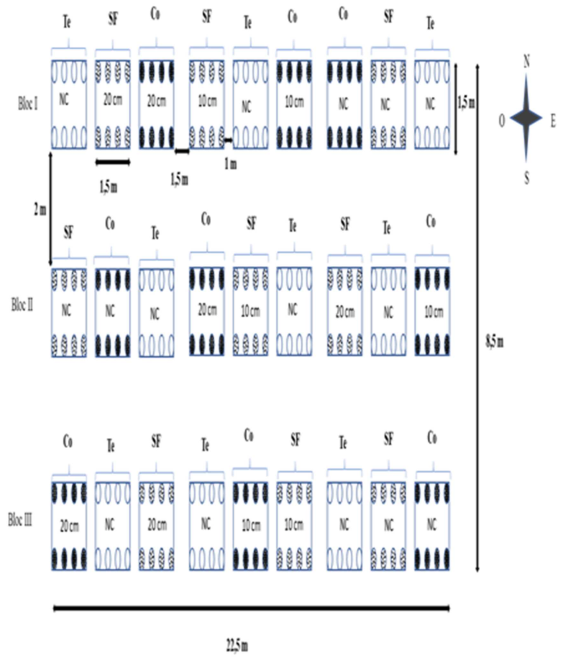
The plant material used was *Artemisia annua* hybrid seed from the hybridization of the Apollo variety and the Médiplant variety offered by the "*Beo nèeré*" agroecological association. The choice of this hybrid species is justified by the fact that it has high artemisinin content in its leaves compared with other species (Graham *et al.*, 2010).

Nursery

The nursery is located in the experimental garden of the University Joseph KI-ZERBO. Seedlings were sown in germinators with holes in the bottom. During the nursery phase, the seedlings were watered twice a day until the 5-leaf stage, using a pressure pump. After the 5-leaf stage, the seedlings were transplanted into one-liter bags, to continue their growth.

Conducting the trial

Fifteen days after transplanting, the most vigorous plants were selected and transported to the experimental site (Ipelcé). At the site, the plants were removed from the bags using a razor blade and planted in a 2-factor block design: primary factor (fertilizer in three modalities, i.e. unfertilized control soil, compost and Fertile Soil) and secondary factor (recutting in three levels, i.e. uncut plants, plants cut 10 cm from the crown and plants cut 20 cm from the crown) in 3 replications (Fig.1). Each block is made up of 9 elementary plots, and each elementary plot comprises four rows with two bunches (1 m apart) per row, i.e. eight bunches per elementary plot. The two middle lines (four bunches) are considered as the experimental unit. A total of 216 plants were planted with 72 plants per block (216=72 × 3).



Legend: Te: Control; Co: Compost; SF: Fertile Soil; NC: uncut; 10 cm: plants cut from the ground; 20 cm: plants cut 20 cm from the ground.

Fig. 1. Factorial block experimental set-up

Determining field capacity

Field capacity is defined as the quantity of water retained by the soil after the excess water circulating in the macroporosity has drained away by gravity, and after the flow velocity has significantly decreased (Veihmeyer and Hendrickson, 1931). It is with this field capacity that plants are watered daily in the absence of rain. The field capacity (CAC) is obtained using the formula of Feodoroff and Betremieux, 1964 defined below:

$CAC = p\ (mm) \times d \times C$

Where p = the sampling depth of the crop soil in mm, d = the soil density and C = the soil retention capacity.

With a sampling depth of 50 mm, a density equal to 1.4 and a retention capacity of 30%, the field capacity of the crop soil is: CAC = 50 mm × 1.4 × 30%.

This gives CAC = 21 mm or 21 l/m^2.

Our crop plots were watered at field capacity, with 10.5 liters at 6:00 am and 10.5 liters at 6:00 pm GMT.

Organic fertilization

To assess the influence of fertilizer type on plant growth and development, two types of organic amendment were used. These were compost (Co) and Fertile Soil (SF). Fertile Soil is a type of compost supplied by the agrobusiness AROM-H/SOLFERTIL. Fertilizers were applied twice: at the first week of planting, i.e. 60 days after sowing, and at the seventh week of planting, i.e. 109 days after sowing.

The quantity of fertilizer applied per poquet (QFO poquet) was determined by the following formula:

$$QFO/poquet = \frac{QFO/ha}{N}$$

Where QFO/ha = quantity of fertilizer per hectare and N= total number of poquets per hectare.

The FAO, 2012, recommends the application of a handful of compost per poquet, i.e. 400 to 600 kg per hectare for higher yields. So, the amount of organic amendment applied here was 500 kg/ha. The dose of organic fertilizer (QFO) applied per poquet in this study was 25 grams with QFO/ha = 500,000 grams and N = 20,000 poquets.

Table 1. Chemical composition of cultivation soil and fertilizers

	Total M.O. (%)	C. total (%)	Total N (%)	C/N	Assimilable P (%)	Assimilable K (%)	pH water
Soil	2,016	1,169	0,063	19	0,1006	0,9577	6,06
Fertile soil	50	30	3	10	4	2	7
Compost	53,22	30,87	1,81	17	2,57	2,56	7,71

Legend: OM: organic matter; C: carbon; N: nitrogen; P: phosphorus; K: potassium

Source: Laboratoire CID ingénierie; 2023

Chemical characteristics of soil and fertilizers

Chemical analysis showed that the cultivation soil has an almost neutral pH (Table 1). The topsoil, compost and Fertile Soil used are rich in organic matter (OM), carbon (C), available nitrogen (N), potassium (K) and assimilable phosphorus (P). Compost contains more organic matter. Fertile Soil, on the other hand, contains more available N and P.

Cutting plants

Re-pruning, which consists in cutting a plant at a certain height from the collar, took place when the highest number of plants reached the required heights (10 cm and 20 cm), to allow the aerial part to develop. Re-pruning took place seven weeks after planting.

Seed germination test

After drying the harvested fruit under shade, a germination test was carried out to determine the viability of the seeds produced. Seeds from the various treatments (control plants, compost-fertilized plants and Fertile Soil-fertilized plants cut at 10 cm and 20 cm) are obtained by rubbing the dried fruit with both hands. 0.1 gram of seeds from the various treatments was taken and mixed with three tablespoons of sifted sand. The homogeneous mixture obtained is sown in line in traditional germinators (cut-out can). To obtain reliable results, germination tests were repeated with different seed samples.

Data collection

Precipitation

The quantity of water and the number of rainy days were recorded throughout the study at the Ipelcé site. To do this, a well-cleared area was set aside for the water collection device (the pluviometer).

Air temperature and relative humidity

Air temperature and relative humidity were recorded every day during the experiment at Ipelcé at 7 a.m., 2 p.m. and 6 p.m. using a THER-D31-001 thermo-hygrometer.

Number of branches

The number of branches was obtained by manual counting before the harvesting. Only primary branches, i.e. those directly linked to the main stem, were considered.

Dry biomass of aerial part and seeds

Using pruning shears, the plants are cut at the collar to obtain the aerial part. The above-ground dry biomass was then obtained after a week's drying under shade (to avoid destroying the active ingredient). After drying, the above-ground biomass and seed dry biomass were determined using a DENVER Instrument AC-1200D electronic balance, accurate to 0.001g.

Chlorophyll content

Relative chlorophyll content was determined on the leaves using a SPAD 502 chlorophyll meter. The reading was taken on the tenth leaf on the main stem from the apex. Readings were given in units known as SPAD (Soil Plant Analysis Development).

Measurement of leaf area index LAI

Leaf area index (LAI) or foliar index (FI) is the ratio of total leaf area to the soil surface on which vegetation grows. LAI was measured under each plant in each elementary plot.

Statistical analysis

Data were entered into Excel (version 2016). Curves and histograms were also produced using this spreadsheet. An analysis of variance with the Newman-Keuls test at the 5% threshold for the different parameters studied, as well as comparisons of the means of the varieties studied, were carried out using XLSTAT 2016 software. ArcGis 10.8 software was used to produce a map of the experimental site.

Results

Precipitation

The total rainfall recorded at the experimental site during the trial period was 733.76 mm, distributed between September and October for 19 days of rain. The month with the highest rainfall was September, with 356.58 mm (Fig. 2).

Air temperature and relative humidity

Air temperature and relative humidity during the experiment evolved in opposite directions (Table 2).

Table 2. Air temperature (T°C) and relative humidity (HR%)

6 hours		2 p.m.		6 p.m.	
T°C	HR%	T°C	HR%	T°C	HR%
25,66±2,14c	74,38±12,44a	32,54±2,14a	53,74±12,44c	29,87±2,14b	62,06±12,44b

The mean temperature at 06h during the trial was 25.66±2.14°C, 32.54±2.14°C at 14h and 29.87±2.14°C at 18h. Average relative humidity was 74.38±12.44% at 06h, 53.74±12.44% at 14h and 62.06±12.44% at 18h. The highest temperature was recorded at 14h and the lowest at 06h. For relative humidity, the highest value was recorded at 06h and the lowest at 14h.

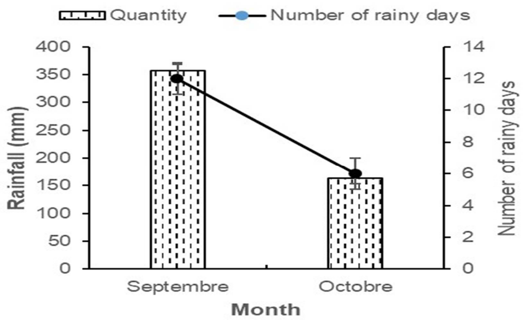
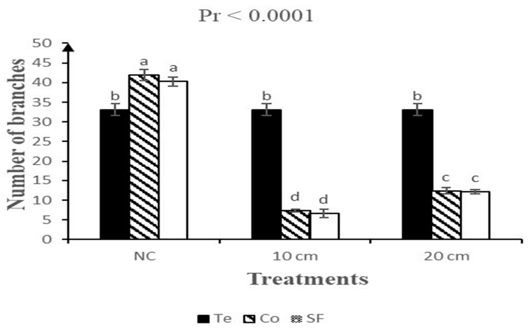


Fig. 2. Rainfall and number of rainy days

Number of branches

The uncut plants had significantly (p<0.0001) more branches than those cut at 10 cm and 20 cm from the crown respectively (Fig. 3). The uncut plants had the highest values of compost (41.92±1.46) and Fertile Soil (40.25±1.09) compared with those cut at 10 cm, which recorded the lowest values for compost (7.33±0.38) and Fertile Soil (6.58±1.04).

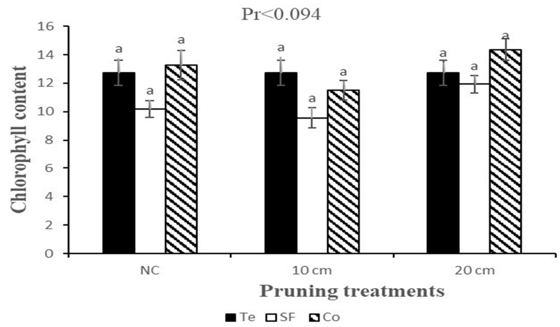


Legend: Te: unfertilized and uncut control; SF: fertile soil; Co: compost; NC: uncut plant; 10 cm: plant cut at 10 cm from crown; 20 cm: plant cut at 20 cm from crown.

Fig. 3. Number of branches according to treatments

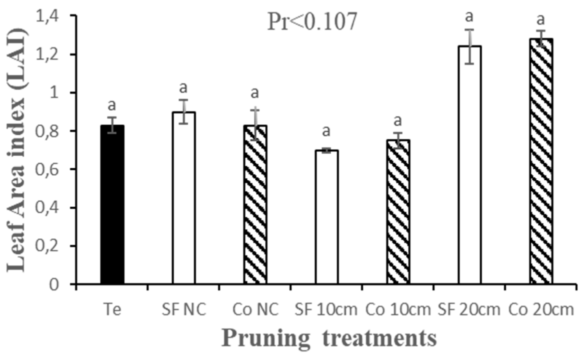
Dry biomass of aerial parts and seeds

The analysis of variance in Table 3 shows a significant difference (p<0.0001) between treatments and total biomass production. Plants fertilized with compost and cut at 20 cm from the crown produced more seed biomass and more total dry biomass, with 12.690±0.66 grams and 49.333±0.87 grams respectively. The unfertilized, uncut control (28.086±0.64) and the compost (28.255±1.47) and Fertile Soil (9.689±1.12) treatments cut at 10 cm did not produce good total biomass.



Legend: SF: fertile soil; Te: control; Co: compost; NC: uncut plant; 10 cm: plant cut at 10 cm; 20 cm: plant cut at 20 cm. Values followed by the same letter in the same column are not significantly different at the 5% threshold; Pr: probability

Fig. 4. Relative chlorophyll content according to different treatments



Legend: Te: control; SF NC: uncut plant (fertile soil); Co NC: uncut plant (compost); 10 cm: plant cut at 10 cm; 20 cm: plant cut at 20 cm. Values followed by the same letter in the same column are not significantly different at the 5% threshold; Pr : probability

Fig. 5. LAI of Artemisia as a function of treatments

Chlorophyll content

Analysis of variance at the 5% level revealed no significant difference between treatments for chlorophyll content. Nevertheless, based on the averages, compost produced more chlorophyll. Fertile Soil recorded the lowest chlorophyll content values in all treatments (Fig. 4). In fact, compost cut at 20 cm from the crown gave the highest value (14.36±0.75) for relative chlorophyll content, while Fertile Soil cut at 10 cm recorded the lowest value (9.56±0.71). The control gave intermediate values (12.73±0.88).

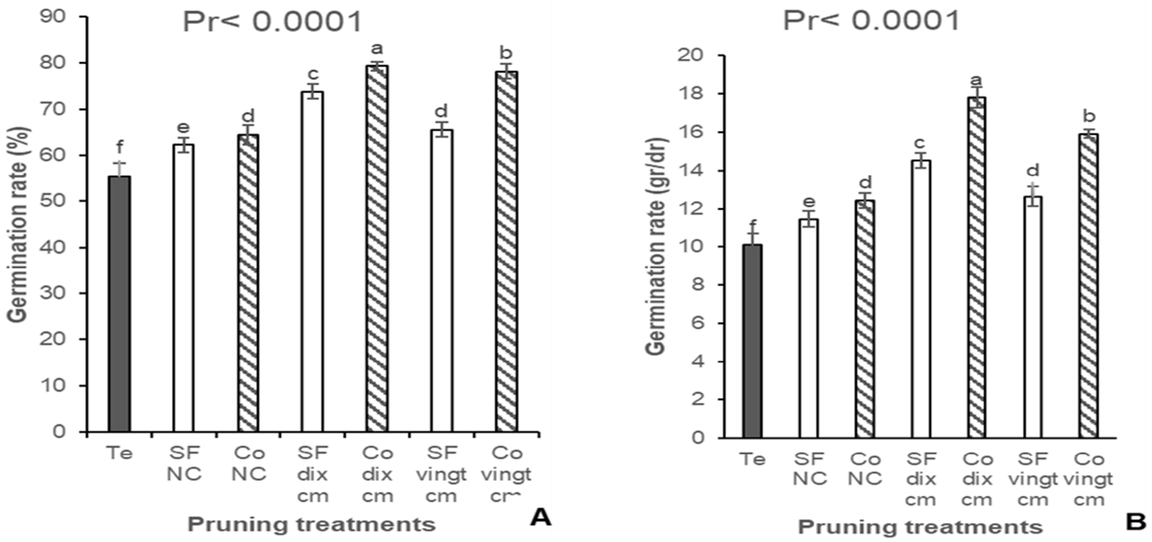
Leaf area index (LAI)

Analysis of variance of LAI revealed no significant difference regarding fertilizer or level of pruning. Nevertheless, three groups or three modes were observed. A decrease in LAI was observed in plants cut at 10 cm, an increase in those cut at 20 cm and an intermediate value in those not cut (Fig. 5).

Table 3. Components of dry biomass production in a real environment

Level of pruning	Fertilizers	Biomass seed (g)	Dry biomass of aerial part (g)
NC	SF	11,198±1 ^{ab}	41,027±1,14 ^{ab}
NC	Co	10,290±0,96 ^{abc}	36,823±1,85 ^{ab}
NC	Te	7,784±0,78 ^{bc}	28,086±0,64 ^{bc}
10 cm	Co	6,879±0,59 ^{bc}	28,255±1,47 ^{bc}
10 cm	SF	2,651±0,59 ^{cd}	9,689±1,12 ^{c}
20 cm	Co	12,690±0,66 ^{a}	49,333±0,87 ^{a}
20 cm	SF	9,638±0,7 ^{abc}	33,752±1,27 ^{ab}
Pr > F		0,0001***	0,0001***

Legend: NC: uncut plant; 10 cm: plant cut at 10 cm; 20 cm: plant cut at 20 cm, Te: control; SF: Fertile Soil; Co: Compost. Values followed by the same letter in the same column are not significantly different at the 5% level; Pr: probability, ***: very highly significant.



Legend: Te: control; SF NC: uncut plant (Fertile Soil); Co NC: uncut plant (Compost); SF ten cm: plant cut at 10 cm (Fertile Soil); Co ten cm: plant cut at 10 cm (Compost); SF twenty cm: plant cut at 20 cm (Fertile Soil); Co twenty cm: plant cut at 20 cm (Compost). Values followed by the same letter in the same column are not significantly different at the 5% threshold; Pr: probability of occurrence.

Fig. 6. Germination rate (A) and germination speed (B) as a function of recutting type.

Germination rate

The germination rates of seeds from cut and uncut plants were significantly different (p<0.0001). Seeds produced by plants fertilized with compost and cut at 10 cm from the crown had the highest germination rate (79.33±1%) (Fig. 6A). The lowest rate was recorded for seeds from the control (55.33±3%).

Germination speed

Germination speed differed significantly (p<0.0001) according to the type of fertilizer and the level of pruning (Fig. 6B.). Indeed, plants fertilized with compost and cut at 10 cm and 20 cm from the crown had significantly higher germination speeds at 17.81±0.56 grs/dr and 15.91±0.22 grs/dr respectively. The lowest values were observed in the uncut Fertile Soil and the control with 11.46±0.42 grs/dr and 10.11±0.61 grs/dr respectively.

Germination time

Seed germination times were significantly different (p<0.0001) depending on the type of fertilizer and the level of cutting (Table 4). Seeds from control plants had a relatively low germination time (78.67±1.53 hours). On the other hand, seeds from plants fertilized with compost and cut at 20 cm and those fertilized with Fertile Soil and cut at 10 cm recorded the highest values with 96±1 hours and 95.67±1.53 hours respectively.

Table 4. Germination time as a function of treatment type

Treatments	Time in h
Co 20 cm	96,00±1,00 a
SF 10 cm	95,67±1,53 a
Co 10 cm	79,00±1,00 b
SF 20 cm	80,00±1,00 b
Co NC	79,33±0,58 b
SF NC	79,33±1,53 b
Te	78,67±1,53 b
Pr > F	0,0001***
Treatments	Yes

Legend: CO 20 cm: plant cut at 20 cm (Compost); SF 10 cm: plant cut at 10 cm (Fertile Soil); Co 10 cm: plant cut at 10 cm (Compost); SF 20 cm: plant cut at 20 cm (Fertile Soil); Co NC: plant not cut (Compost); SF NC: plant not cut (Fertile Soil); Te: control; ***: very highly significant. Values followed by the same letter in the same column are not significantly different at the 5% threshold; Pr: probability

Discussion

The results of the analysis of variance for the different fertilizers showed that they are relatively rich in organic matter. On the other hand, the results for soil mineral content at the experimental site showed a high C/N ratio of 19. This means that there is not enough nitrogen, or that carbon mineralization is slow. Only a small amount of nitrogen is returned to the soil. Fertial and IFC, 2010, stated that plants need macroelements such as nitrogen to ensure their development. In this study, the soil at the site had a low percentage of nitrogen. This would have reduced above-ground biomass production. Indeed, unfertilized plants (control) did not produce much above-ground biomass (20.302±0.29 grams). During our experiment, only 19 rainy days were recorded, with a total rainfall of 733.76 mm. This shows that rainfall is unevenly distributed over time, even during the rainy season in the Sahel. This uneven rainfall distribution justifies supplemental irrigation of *Artemisia annua* plants to avoid exposing the plants to water deficit. This water deficit generates water stress, which reduces plant growth and development. Ganse and *al.*, 2014 observed that the development of *Artemisia annua* L. is sensitive to environmental variables (rainfall, humidity, insolation, temperature, substrate, etc.). Temperature averages were high (temperatures between 25.66°C and 32.54°C) during the study. These high temperatures would have reduced plant growth and development in the various treatments. According to Gingade and *al.* 2014, the optimal growth temperature for *Artemisia annua* is between 17.6°C and 28.4°C. The recutting results showed that uncut and fertilized plants branched more. Indeed, uncut plants fertilized with compost (41.92±1.46) and Fertile Soil (40.25±1.09) branched much more than those cut at 10 cm from the collar, which recorded (7.33±0.38) and (6.58±1.04) for compost and Fertile Soil respectively. This could be explained by the fact that the meristem of plants cut at 10 cm was severely damaged and did not allow the plant to develop the aerial part properly. In fact, recutting at 10 cm from the crown would traumatize the axial meristems, thereby reducing or even preventing the production of the hormone responsible for branching (cytokinin).

The results of the chlorophyll content analysis showed that there was no significant difference between the Fertile Soil, compost and control treatments. The averages obtained, however, revealed that compost cut at 20 cm from the crown gave high values (14.36±0.75 branching out) compared with the control and Fertile Soil cut at 10 cm, which gave 12.73±0.88 branching out and 9.56±0.71 branching out respectively. This could be explained by the fact that compost, which enables plants to produce more chlorophyll than the control and Fertile Soil, contains more mineral elements that could be easily used by the plant. Indeed, compost has a high nitrogen and potassium content, which are directly involved in the synthesis of chlorophyll (nitrogen) and in the activation of numerous enzymes involved in photosynthesis. Mounirou, 2022, had also demonstrated with onions that both biochar and manure treatments gave a higher concentration of chlorophyll. This shows that plants treated with biochar and manure are greener than the other treatments. The low values obtained with Fertile Soil could be due to the insufficiency or lack of mineral elements.

The analysis of variance of the leaf area index between the control and the cut plants revealed no significant difference. On the other hand, a comparison of averages revealed three trends: a high LAI value for plants cut at 20 cm above ground level, an intermediate value for those not cut, and a low value for those cut at 10 cm above ground level. The high LAI value for plants cut at 20 cm may be due to the fact that they produced more above-ground biomass than the other treatments. Norman and Arkebauer, 1991; Van Oosterom *et al.*, 2002 and Lindquist *et al.*, 2005, asserted that biomass production at crop level is a function of the amount of radiation intercepted by the canopy, in relation to the size and distribution of the leaf surface. Although cut plants had few branches, they have a canopy in the shape of a russet, enabling them to provide considerable shade. Ayaz *et al.*, 2004, asserted that the high rate of leaf cover leads to rapid canopy closure, which would increase their LAI. In fact, plants cut at 20 cm will tend to produce several lateral branches, thus increasing the thickness of the shade. In the case of uncut plants, branching occurs. However, this does not provide a good shade thickness, as the plant only grows in height. In the case of plants cut at 10 cm, there was little branching, so no shading was achieved.

For biomass production, fertilized plants had significantly ($p<0.0001$) higher values than unfertilized plants. Plants fertilized with compost and cut at 20 cm had higher values of above-ground dry biomass (49.333±0.87g) and seed biomass (12.69±0.66g) than the above-ground dry biomass (28.086±0.64g) and seed biomass (7.78±0.78g) of the control. These plants fertilized with compost and cut at 20 cm had higher values of above-ground dry biomass and seed biomass also higher than the above-ground dry biomass (9.689±1.12g) and seed biomass (2.65±0.59g) of plants cut at 10 cm and fertilized with Fertile Soil. N'Zue and Doumbia, 1998 obtained the highest average number of cuttings (4.9 cuttings/plant) from cassava plants re-cut at a height of 10 cm from the ground. In this case, however, it was the plants cut at 20 cm and fertilized with compost that had a high biomass production. This could be explained by the physical and chemical properties of compost. In fact, compost, along with soil, makes a good growing substrate with good water retention capacity for *Artemisia annua* L. Substrates with good water retention capacity, easily usable by growing plants, are able to produce 150 kg of dry leaves per hectare on dry land (Sounon *et al.*, 2009). The compost used in this experiment contains more carbon and nitrogen. By using carbon and nitrogen, microorganisms break down organic matter and release the other nutrients it contains. These become available to plants. It is through this process that organic fertilization feeds plants (Petit and Jobin, 2005). The richness of the compost in organic matter would have contributed to plant fertilization. This, in turn, would have encouraged the production of large quantities of aboveground biomass and seeds.

The germination test carried out on the seeds produced showed that there was a highly significant difference ($p<0.0001$) on the factors studied (fertilization and pruning). In fact, seeds from plants fertilized with compost and cut back to 10 cm (77.78%) germinated more. This could be due to the fact that pruning at 10cm traumatized the plants, causing stress which developed a species survival mechanism in these plants. According to Nguinambaye *et al.*, 2020, the accumulation of carbon and protein substrates in the seeds during stress shows that the plant gives priority to the production of viable seeds. It's as if the plant wants to preserve its vital organs to safeguard the species. The highest germination rate (17.81gr/dr) was also recorded in the seeds of compost-fertilized plants cut at 10 cm. Sounon *et al.*, 2009 asserted that seed germination rate and speed evolve together.

The results of the analysis on germination time showed a significant difference ($p< 0.0001$) between the different treatments applied. The highest values were obtained for plants planted at 10 cm and fertilized with Fertile Soil, and for plants planted at 20 cm and fertilized with compost, with 96±1 hours and 95.67±1.53 hours respectively. The unfertilized and unseeded control plants took less time to germinate (78.67±1.53 hours). The long germination time in the seeds of rethreaded plants is thought to be due to an extension of the dormancy time induced by mechanical stress, in this case rethreading. According to Mehra and *al.,* 2022, abscisic acid is produced by the plant under stress. This acid, which induces seed dormancy, is said to have prolonged seed dormancy in recut plants.

Conclusion

Artemisia annua L. has been used for over two thousand years for its antimalarial properties. This study showed that the plant can be cultivated in Burkina Faso for its aerial biomass, which contains more artemisinin, and for its seeds. The results obtained in this study showed that plants fertilized with compost and harvested at 20 cm above ground level produce more above-ground dry biomass. As for the quality of the seeds produced, the seeds of plants fertilized with compost and cut back to 10 cm had more germination rate or capacity. In short, we can say that the germinative capacity of seeds produced by *Artemisia annua* L. increases when it is stressed by recutting.

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