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Studies on German Chamomile (*Matricaria recutita* L.) propagation and the effect of light and age on seed viability

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1 ABSTRACT

Chamomile (*Matricaria recutica*) is a herb grown for its flowers which have medicinal properties and are used to make tea and for oil extraction. The current research was carried out to determine the effect of light and age on germination of chamomile seeds and to compare vegetative (use of cuttings) and seed propagation methods. In the first experiment chamomile seeds were sown in 10 Petri dishes lined with moistened paper towel to retain moisture. Half of the Petri dishes were covered with aluminium foil to prevent entry of light while the rest were exposed to sunlight. In experiment 2 chamomile seeds were sown in a nursery bed. The seedlings were transplanted to the field at 6 weeks and raised to maturity (flower production). Cuttings were obtained from mature plants and rooted in polythene sleeves filled with soil before transplanting into the main seedbed. Results showed that the seeds germinated by the 4th day and light did not affect germination. Plants raised by use of cuttings took a shorter period to flower compared to those raised from seeds. Based on the results we recommend that chamomile seeds can be sown directly without covering with soil and that cuttings can be used to increase the number of plants. The results of this study will encourage farmers to adopt production of chamomile as an alternative cash crop since the crop is relatively easy to produce. More research should be carried out on other agronomic practices such as nutrition, weeding and water management.

INTRODUCTION

Chamomile (*Matricaria recutita* L*)* is one of the important medicinal herbs native to southern and eastern Europe. It is widely grown in Germany, Hungary, France, Russia, Yugoslavia, Brazil and India. Hungary is the main producer of the flowers for export to Germany for distillation of the oil (Ompal, 2011). In Kenya it is grown in Meru for export (Bob, 2013).Chamomile has been used in herbal remedies for thousands of years in ancient Egypt, Greece, and Rome and the chamomile drug is included in the pharmacopoeia of 26 countries (Saber and Khalid, 2009). It is a constituent of several Traditional Arab medicine, and homeopathy medicinal preparations. As a drug, it is used for the management of flatulence, indigestion, hysteria, and fever. The flowers contain essential oil between 0.2 to 1.9%, of which the main component is chamazulene. The active principles are anthemic acid, tannic acid and glucoside (Macky *et al.*, 2011). Externally, the

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drug may be applied as powder to treat wounds, skin conditions, inflammation of the mouth, throat, and the eyes (Macky *et al*., 2011). The oil is also used in perfumes, cosmetics, and in food industry. In a past study, herbal tea preparations eliminated colic in 57% infants (Weizman, *et al*., 1993). Because of its extensive pharmacological and pharmaceutical properties, the plant has significant economic value and could therefore increase the incomes of small scale farmers in Kenya. Chamomile is an annual plant with thin spindle-shaped roots that penetrate shallowly into the soil and grow to a height of 10–80 cm. German chamomile can be grown on a wide range of soils (provided it is light and well drained), temperature (2 to 20°C) and pH conditions up to 9 (South Africa Department of Agriculture. 2009).Temperature and sunshine hours affect essential oils and azulene content more than soil type (Kercher, 1966). The plant can be propagated through seeds either by direct sowing or transplanting; or vegetatively by use of cuttings. The seeds are very minute with a thousand seeds weighing 0.088–0.153 gm. Some reports suggest that the seed need light to germinate and therefore should be covered lightly (Mounir and Gilles, 1991). Seed germination starts within 4–5 days of sowing, the seedlings are ready for transplanting within 4–5 weeks (Srivastsra *et al.,* 2011), and growth depends on moisture conditions in the field. Direct sowing of seeds usually results in poor germination, hence transplanting is preferred (Ompal *et al,* 2011). Fresh and dry flower yield of 6.65t/ha and 1.88t/ha, respectively, have been recorded under research conditions (Nidagu *et al*, 2006). Various insects, fungi, and viruses attack chamomile including whiteflies (*Bemisia tabaci*), aphids (*Aphis fabae*), spider mites (*Urtica spp*) and thrips. The crop promotes proliferation of beneficial insects such as bees and ladybugs and therefore contributes to biodiversity. German chamomile is the fifth top selling herb in the world (CIMAP,1995). The high price of chamomile in the market presents an opportunity for farmers in Kenya to increase incomes and diversify their income base. The crop takes a short period of time to mature, about two months, which makes it a good candidate for use as a fallow crop, or in areas that have short rainfall period. In addition the crop does well even in nutrient poor soils thus the level of input is relatively low. Unfortunately information on appropriate agronomic and post harvest practices is not available, including on seed management. By developing an agronomic protocol that will foster the production of the crop in the country, living standards of Kenyan farmers are likely to improve because the crop fetches better prices than classical crops. This research aimed to develop an agronomic package that could be adopted by farmers who want to grow Chamomile with focus on propagation methods. The specific objective was to determine whether light and age affects germination of Chamomile seeds, and to compare vegetative and seed propagation methods.

MATERIALS AND METHOD

The research was carried out at Kenyatta University, School of Agriculture farm from November to March 2014. The farm is located at Ruiru, altitude of 1564 MASL. The average high from November to March is 24.3, 24.5, 26.2, 27.6, and 27.1^{0}C respectively. The average precipitation for the same months is 150,80,50,44, and 103mm respectively (climatedata.eu). Evaluation of the effect of light: To evaluate the effect of light on seed germination, Chamomile seeds were sown in 10 Petri dishes lined with moistened paper towel to retain moisture. Half of the Petri dishes were covered with aluminium foil to prevent entry of light while the rest were exposed to sunlight. Data on mean germination and days to germination was recorded daily from the 3rd to the 7th day after sowing. Comparing seed and

vegetative propagation: A nursery bed was prepared by working the soil well to break the clods and removing weeds, stones and stubble after which 1 gram of chamomile seeds was mixed with fine sand and sown by broadcasting on the surface. Data was collected on the number of days from sowing to germination of the seeds and mortality of seedlings. When the seedlings matured they were transplanted to the field on seedbed that had been prepared by ploughing the soil into fine tilth, and raised to flowering stage. Data on number of days from seedling to flowering, and number of branches per plant was recorded. Cuttings were obtained from the mature plants and rooted in polythene sleeves containing soil before being transplanted into the main seedbed. Data on days to rooting and days to flowering of plants raised from cuttings was recorded. A comparison was made between the two propagation methods in order to recommend the most suitable one based on the ease of production, period to maturity and reliability.

Evaluation of the effect of age on seed viability: Two batches of seeds, one approximately six months old and stored under room temperature, $23^{\pm}2^{0}$C, and another, 1 month old were sown in Petri dishes lined with moistened paper towel to retain moisture. Seeds from each batch were replicated five times and data on days to germination and mean germination was recorded from the 3rd to the 7th day.

Experimental design: Experiments were set as a randomized complete block design with five replications. A replication consisted approximately of 100 seeds. Irrigation was carried out as often as the soil was dry. Statistical Analysis System Software (SAS) was used to analyze the data. Graphs were generated using Microsoft excel.

RESULTS

In experiment one, the seeds that were exposed to light and those covered up germinated by the 4th day and there was no significant difference in germination regardless of exposure to light. In experiment two most of the seeds germinated and some were selected to be transplanted into the main seedbed. Transplanting was 42 days after germination when the seedlings had reached 3 inches in height. All the seedlings transplanted into the main seed bed grew to full maturity. First flowering was observed at 27 days after transplanting while full flowering was observed after 35 days. The mean height attained was 35 cm, with each plant having 15 to 20 branches. In total the plant took 68 days from seed to flowering. Cuttings developed roots by the 16th day after detachment and were transplanted from the sleeves on the 20th day. In experiment three seeds from the six month old batch germinated from the 4th day while seeds that were less than a month old (fresh batch) did not germinate at all.

DISCUSSION

Based on the results the research concluded that light is not necessary for the germination of chamomile seeds. Other similar studies on false chamomile (a weed of the same genus) by Mounir and Gilles (1991) have found that germination was lower (39%) in darkness at 5 to 15^{0}C than on light (89%). This implies that non transparent mulching materials can be used to cover the seed before germination in order to conserve moisture. This can lead to reduced watering frequency which reduces labour and input costs. Death of the seedlings was caused by pests (millipedes and grasshopper) and wilting due to the superficially attached roots in combination with high temperature; and dislodging of seedlings during watering. The study confirmed that shallowness of the roots makes the seedlings highly susceptible to moisture shortage in soil. This finding agrees with Ompal *et al.* (2011) who recommended

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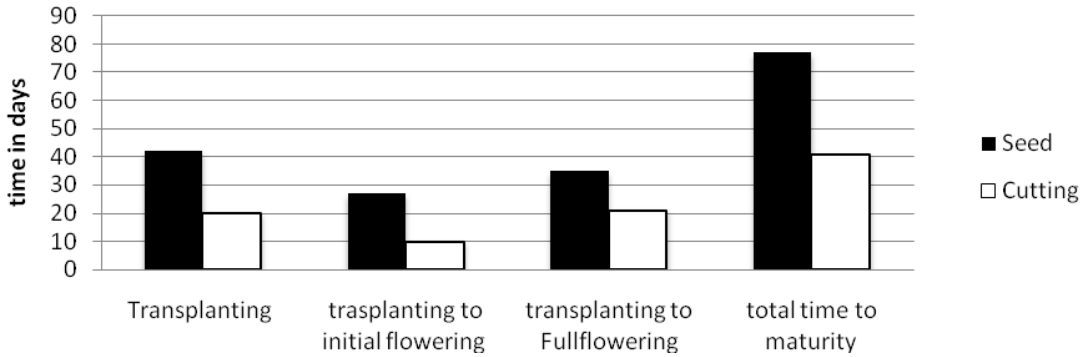
that "Moisture conditions in the field for direct sowing of seeds must be very good otherwise a patchy and poor germination is obtained". The 27 days to flowering and 35 days to full bloom were shorter than two to three months reported by Nidagundi *et al, (*2006). The reason for early maturity could be the high temperatures of above 27^0C in the area but this should be further investigated. The early maturation could be an advantage as it reduces the time the crop takes in the field, enabling as many as 5 cropping per year. Furthermore, the short growth period makes chamomile a good fallow in addition to being a good candidate in areas that experience short rains of less than three months. Cuttings wilted during the first two days after planting but rapidly recovered thereafter. After 11 days the cuttings began to develop new roots and by the 16th day they had fully rooted. This was also shorter than 21 days reported in other publications. Since the cuttings were obtained from mature plants, flowering was observed as soon as the cuttings began to grow and full bloom was 42 days from the time cuttings were obtained. Although it reduced the time, the immediate flowering could impose stress on the plant, reducing its productivity, and the benefit should therefore be further validated. The effect of age of seed on the germination of chamomile seeds could not be conclusively established as the seeds from the fresh batch failed to germinate. Research by Matheri and Maina (2014) found that 60 day old seed germinated in the shortest period (3 days), while 0 day old seeds took 7 days to germinate. Further research is needed to investigate these seemingly conflicting observations. The research concluded that it is possible to grow chamomile from seed to full maturity and that chamomile grown through seeds takes longer at the seedling stage than it takes in the vegetative stage. Propagation of chamomile through cutting is much faster than the use of seed although there are limitations to the number of plants that can be propagated at a time. From the findings we recommend chamomile to be propagated by use of cuttings to increase the number of plants in case seed is not readily available. At nursery level the watering method that does not cause soil translocation such drip irrigation should be used. More research should be carried out on other agronomic practices such as nutrition, weeding and irrigation.



Graph 1: comparing seed and vegetative propagation techniques

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Chamomile plants raised from cuttings (left); a sprouted cutting showing roots. Plants raised from cuttings flowered after 42 days.


Seeds from chamomile plant (left); and seedlings germinating from seed (right). Plants raised from seed flowered after 77 days.

Matured flowered chamomile plants of two varieties used in the experiment.

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