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EFFECTS OF SOWING DATE AND PRE-TREATMENT METHODS ON SEED EMERGENCE AND YIELD OF YARROW (*Achillea santolina*)

Bahram Mirshekari and Reza Siyami
Department of Agronomy and Plant Breeding, Tabriz Branch, Islamic Azad University, Tabriz, Iran
E-Mail: Mirshekari@iaut.ac.ir

ABSTRACT

There is a little information about influence of physical seed treatment methods on yielding potential of medicinal plants. The present study was conducted to improvement of seed emergence and yield of yarrow by physical treatments especially in late sowing date. The experiment was conducted at Tabriz, Iran. The yarrow seeds were treated by ultrasonication, laser, magnetic field, gamma and beta irradiations all for 3.5 and 5 min. In the field study seeds were hand sown on 5th and 20th May. LSD test (P=0.05) was used to compare the differences among treatment means. All the seed priming treatments improved the coefficient of uniformity of emergence the effect of studied treatments on final emergence percentage was significant. Seedling vigor index from seeds treated with gamma and beta irradiations was found to be similar to that of control. When seeds were sown on 5th and 20th May, harvesting stage in the plots treated under magnetic field and ultrasonic happened 101 and 88.8 days after sowing respectively. There is no significant difference between biological yields of yarrow from sowing dates of 5th and 20th May. Seeds priming by ultrasonic wave and magnetic field is recommended for improving crop performance and yield in delayed sown plants.

Keywords: yarrow, crop performance, exposure time, late sown, ultrasonication.

INTRODUCTION

Yarrow (*Achilleasantolina*) is a perennial herb from Asteraceae family, 15-30 cm high, woolly-canescent, with stems erect to ascending, simpleor branched, leafy up to the inflorescence; the leaves are narrow, linear, and green and divided into three ovate-orbicular spinulosedenticulate lobules. The heads are radiate, in compound corymbs. The farmers in the medicinal plants zone of Tabriz in Iran principally grow late maturing varieties, and the occurrence of rain during land preparation operation may cause a delay of 2-3 weeks in sowing. Therefore yield harvest is generally delayed at most of the farms in this area, and because of low temperature prevailing in the middle of September yield decrease [1]. Good crop establishment is one of the major challenges in crop production and its importance is recognized by farmers as well as researchers [2]. Seed priming has been found a doable technology to enhance rapid and uniform emergence, high vigor, and better yields in medicinal and vegetable species [3].

There is a little information about influence of physical seed treatment methods on yielding potential of medicinal plants [4]. Ultrasonic irradiation led in the early emergence and therefore early ripening of vegetable crops by 5-10 days [5]. Lower doses of gamma irradiation positively affected growth and seed yield of okra (*Abelmoschusesculentus* L.) than the control [6]. In another experiment conducted to explore the possibility of improving late sown wheat performance by seed priming techniques seeds emergence, stand establishment, allometry, grain yield, and harvest index, improved significantly. However, seed priming techniques did not affect plant height, number of spikelets, and 1000 grain weight [7]. The present study was conducted to improvement of seed emergence and yield of yarrow by physical treatments especially in late sowing date.

MATERIALS AND METHODS

Site description

The experiment was conducted at the Research Station of the Islamic Azad University, Tabriz, Iran. The yarrow dry seeds were differently treated by ultrasonication, laser, magnetic field, gamma and beta irradiations all for 3.5 and 5 min. Seeds receiving no prior treatment served as control. Twenty five physical primed seeds for each treatment were placed in pots (19×21 cm) containing farm soil under green house conditions (25±1 °C) for anemergence test in green house condition. Final emergence percentage (FEP) was calculated as the cumulativen umber of germinated seeds with normal radicles by using equation 1, as described by Larsen and Andreasen [8].

$$FEP = \Sigma n / N \times 100 \quad (1)$$

Where, n is the number of germinated seeds at each counting and N is total seeds in each treatment. Time taken to 50% of emergence of seedling (E_{50}) was calculated according to the following formula of Coobear *et al*. [9].

$$E_{50} = t_i + (N/2\text{-}n_i)\ (t_j\text{-}t_i)/n_j\text{-}n_i \text{Equation} \quad (2)$$

Where N is the final number of emerged seeds, and n_i and n_j are the cumulative number of seeds emerged by adjacent counts at times $t_i$and t_j when $n_i<N/2<n_j$. Mean emergence time (MET) was calculated according to the equation (3) [10]:

$$MET= \Sigma Dn/ \Sigma n \text{Equation} \quad (3)$$

Where n is the number of seeds which emerged on day D, and D is the number of days counted from the

beginning of emergence. Coefficient of uniformity of emergence (CUE) was calculated using the formula of Bewley and Black [11]:

$$CUE = \Sigma n / \Sigma[(t - \bar{t}) \times n] \quad (4)$$

Where t is the time in days starting from day 0, the day of sowing, n is the number of seeds completing emergence on day t and t is equal to MET. Seedling vigor index (SVI) was calculated according to Abdul-Baki and Anderson [12] by using equation (5).

$$SVI = SDW \times FEP \quad (5)$$

Where, SDW is seedling dry weight.

In the field study seeds were hand sown on 5th and 20th May with seeding rate of 1.5 kg ha^{-1}. Nitrogen was applied at the rate of 60 $kg.ha^{-1}$, of which 50% was applied basally and the rest at 30 days before flowering. Weeds were hand removed during growing seasons. LSD test (P=0.05) was used to compare the differences among treatment means.

RESULTS AND DISCUSSIONS

Minimum time to start emergence, time taken to 50% of emergence of seedling and mean emergence time were recorded fromultrasonication, laser irradiation and magnetic field for both exposure times and only lower dose of gamma irradiation. When seeds treated under beta irradiations and higher exposure time of gamma, time to start emergence, E_{50} and MET were statistically same as control (Table-1). Beneficial effect of seed priming on seedling emergence is consistent with the farmers' perceptions of its effects on some other medicinal plants such as cumin (*Cuminumcyminum* L.) and marigold (*Calendula officinalis* L.) [13]. All the seed priming treatments also improved the CUE compared with non-primed seeds; however, maximum CUE was recorded from ultrasonic followed by magnetic field treatments (Table-1). A lot of works have recently been done on the invigoration of seeds [14] that improves seed performance and provides faster and synchronized germination. The effect of studied treatments on final emergence percentage was significant. The averaged FEP from magnetic field and ultrasonic-primed seeds was nearly 67%, but only 42.5% from laser, beta and higher dose of gamma irradiations, which was statistically same as control (Table-1).

Table-1. Effect of seed priming techniques on seedling emergence and stand establishment of yarrow.

Priming agents and exposure times	**Time to start emergence** (days)	**E_{50}** (days)	**MET** (days)	**CUE**	**FEP**	**SDW** ($g.plant^{-1}$)	**SVI**
Ultrasonic 3.5 min.	13.5	21.0	25.0	0.79	65.0	0.66	42.9
Ultrasonic 5 min.	13.5	23.0	25.5	0.75	68.1	0.66	44.9
Laser 3.5 min.	14.0	24.0	27.0	0.66	46.0	0.49	22.5
Laser 5 min.	14.0	24.0	27.0	0.65	45.0	0.49	22.1
Magnetic field 3.5 min.	13.9	22.5	26.6	0.73	69.1	0.59	40.8
Magnetic field 5 min.	13.9	22.5	26.1	0.77	65.6	0.58	38.0
Gamma 3.5 min.	13.0	24.0	26.5	0.54	48.1	0.45	21.6
Gamma 5 min.	17.5	28.5	29.0	0.36	48.1	0.45	18.6
Beta 3.5 min.	17.5	28.0	29.0	0.31	40.0	0.40	16.0
Beta 5 min.	18.0	27.9	29.0	0.31	40.0	0.40	16.0
Control	17.4	27.9	28.3	0.21	38.4	0.45	17.3
LSD 5%	1.9	3.8	1.7	0.08	7.59	0.07	4.10

In the pot experiment maximum SDW (0.66 $g.plant^{-1}$) was noticed in ultrasonic treatments for 5 min. followed by magnetic field treatments (0.59 $g.plant^{-1}$), and the lowest from treatments of gamma, beta and control (Table-1). Seedling vigor index responded positively and significantly to seed priming agents as compared to that of non-priming. The data shows that SVI can be increased by seed priming with the same trend of SDW as observed above. Besides, SVI from seeds treated with gamma and beta irradiations was found to be similar to that of control. Seed priming has been shown to enhance speed of germination, reduce the time between sowing to emergence, improves seedling vigor, stand establishment and increase yield [15].

When seeds were sown on 5th and 20th May, harvesting stage in the plots treated under magnetic field and ultrasonic happened 101 and 88.8 days after sowing respectively (Figure-1). It seems that primed seeds are better able to complete the process of emergence in a short time and cope with probably environmental stresses. This early and unformed stand establishment enables the crop to complete other phonological events in the crop ontogeny well in time [16]. Besides, Gupta and Hunsigi [3] have reported that primed peppermint plants grew

more vigorously flowered earlier and yielded higher. In the present study there was no significant difference among laser, gamma and beta irradiations with a view to time to harvesting, and in all plots crop plants completed their vegetative growth period 106.8 days after sowing.

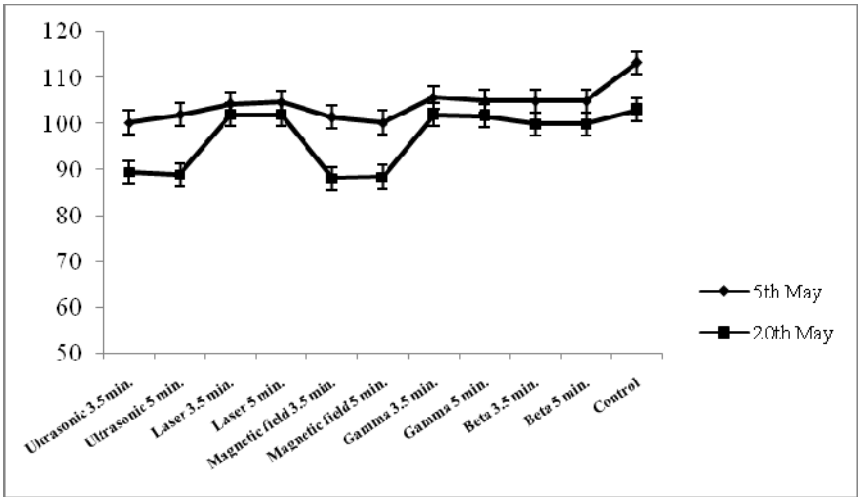

Figure-1. Time from sowing to harvesting of yarrowas affected by seed priming techniques and sowing date.

CCIonly affected by seed priming agents. Seeds primed by magnetic field and ultrasonication had high chlorophyll in leaves (Figure-2). Racuciu *et al*. [17] in their study of priming corn seed with different doses of magnetic field concluded that CCIwere decreased by its lower doses (50 MT), while it was increased by using higher irradiations (100-250 MT). Under field conditions, there is no significant difference between biological yields ofyarrowfrom sowing dates of 5th and 20th May, and the yield ranged from 2111 kgha^{-1} in control up to 3216 kgha^{-1} inultrasonic treatment at 3.5 min. exposure time followed by magnetic fields (Figure-3). Magnetic fields are environmental factors that effect on plants and magnetic field treatment of seed as reported by Dhawi *et al*. [18] stimulates seed germination and improves yielding potential of crop plants. Gupta and Hunsigi [3] concluded that different physical seed priming treatments in peppermint (*Menthapiperita*) seeds was the most effective to get maximum herb yield and net return in both varieties. In Yaldagard *et al*. [19] study, barley yield increasing value from ultrasonic treatment was by 6.53%. These are probably due to increased FEP, as a result of ultrasonic treatment of seeds.

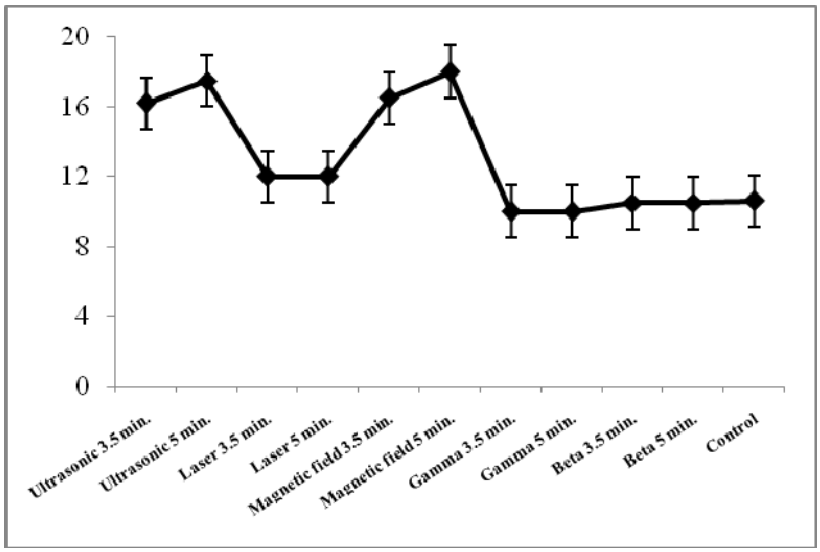

Figure-2. Effect of seed priming techniques on chlorophyll content index.

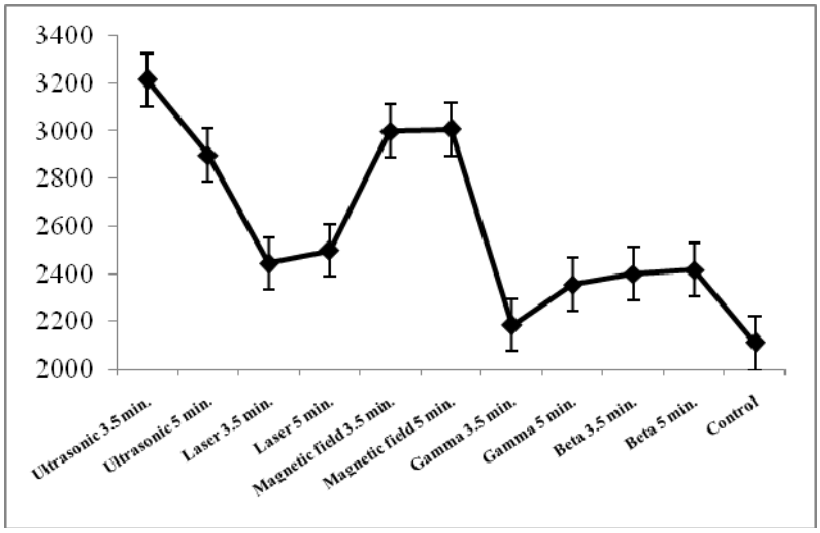

Figure-3. Effect of seed priming techniques on biologic yield.

CONCLUSIONS

Seeds priming by ultrasonic wave and magnetic field is recommended for improving crop performance and yield in delayed sown plants.

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