

Effect of Various Densities of Lamb's-Quarters and It's Emergence Times on Physiological Characteristics of Lamb's-Quarters and Marigold Flower Yield

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Abstract: A field experiment was conducted to study lamb's-quarters competition with marigold during 2010 at Tabriz, Iran. Treatments were lamb's-quarters densities (0, 2, 4, 6 and 8 plants per meter row) and weed emergence times (0, 10, 20, 30 and 40 days after marigold emergence: DAE). The factorial set of treatments was arranged as a RCB design with 3 replications. In full-season interference of lamb's-quarters it's LAI reached up to 0.84, but only 0.28 when they emerged 40 DAE. Weed chlorophyll content index ranged from 16.2 in those treatments having emerged lamb's-quarters plants 30 and 40 DAE to 27.8 in the plots of competition of lamb's-quarters along with the marigold. Lamb's-quarters emergence time was more effective than it's density on weed dry matter. Our trial suggests that weeds emerging several days after that of marigold may have a minimal adverse impact on yield even when present at high densities. On the base of regression analysis results attributes as weed biomass production and it's leaf area index could explain 81.3% of marigold flower yield changes.

Key words: Full-season interference • Lamb's-quarters • Marigold • Regression analysis

INTRODUCTION

Weeds may significantly reduce yield, impair crop quality and cause serious financial loss to farmers. Weeds are also considered to be responsible for about 10% crop yield losses in the world [1]. *Calendula* is a poor competitive plant with weeds and it's ability to compete against weeds in Iran relies heavily on the application of herbicides [2]. Lamb's-quarters (*Chenopodium album*) is a fast-growing annual weed and it is considered to be a noxious weed and causes serious crop losses [3]. When making management decisions, it is important to remember that intensity of weed competition with crops depends on plant species and cultivar, climate, weed population density, competitiveness of weeds in the region and weed interference duration [4]. Redroot pigweeds those emerged earlier than crop plants were taller and produced greater biomass than late emerging ones [5]. In a study conducted by Valizadeh and Mirshekari [6] crop chlorophyll content index changed from 78.9 in control to 57.6 in full season interference of 12 lamb's-quarters plants with crop. Also, green bean biomass was affected by early-emergence of redroot pigweed, but was not reduced

when redroot pigweed emerged along with crop and grew until four weeks after green bean emergence [7]. The present study was conducted to determine the effect of various densities of lamb's-quarters and it's emergence times on physiological characteristics of lamb's-quarters and marigold flower yield.

MATERIALS AND METHODS

A field experiment was conducted to study lamb's-quarters competition with marigold during 2010 growing season at Tabriz, Iran. Treatments were five lamb's-quarters densities (0, 2, 4, 6 and 8 plants per meter row) and relative times of weed emergence (0, 10, 20, 30 and 40 DAE). Dates of weed emergence were selected in such a way to conformed to the critical weed-free period of marigold. The factorial set of treatments was arranged as a randomized complete block design with three replications. A *Kampar*, local variety of marigold, was sown at 6 kg ha⁻¹ in 40-cm rows. To break dormancy of lamb's-quarters seeds were presoaked in a 100 ppm GA₃ solution. Then seeds with heavy densities were mixed with sand and the mixture was broadcasted on the soil

surface in furrows in each plot and lightly raked into the soil. At maturity marigold and lamb's-quarters plants at the center 1-m² portion of each plot were hand harvested.

To formulate the relationship between independent lamb's-quarters growth variables measured in our experiment with marigold dry flower yield as a dependent variable, multiple regression analysis was carried out for the leaf area index (X_1), leaves chlorophyll content index (X_2) and biomass production (X_3) by lamb's-quarters. The multiple regression equation is shown as follows:

$$\text{Marigold flower yield (g m}^{-2}\text{)} = 0.601 + 0.0033 (X_1) + 0.0089 (X_2) + 0.00010 (X_3)$$

Furthermore, the stepwise regression analysis was also carried out for the data obtained to test the significance of the independent variables affecting the marigold flower yield. The resulted stepwise regression equation is shown as follows:

$$\text{Marigold flower yield} = 4.70 - 0.0528 (\text{weed biomass production}) - 0.0333 (\text{weed leaf area index});$$

$$R^2 = 81.3\%$$

RESULTS AND DISCUSSION

In full-season interference of lamb's-quarters plants it's LAI reached up to 0.84, but only 0.28 when they emerged 40 DAE (Table 1). Leaf area is a major factor in interception of solar radiation, photosynthesis and biomass accumulation in crop canopies [8]. Weeds emerging before or along with the crop are very competitive. Emerging of two redroot pigweed plants per meter along with soybean (*Glycine max*) reduced crop yield by 12%, but their emergence at the two-nodal stage of soybean caused no yield reduction [9].

Effect of lamb's-quarters emergence time on it's leaves chlorophyll content index (CCI) was significant. Weed CCI among treatments ranged from 16.2 in those treatments having emerged lamb's-quarters plants 30 and 40 DAE to 27.8 in the plots of competition of lamb's-quarters along with the marigold (Table 1). On the other hand, lamb's-quarters seedlings that emerged 30 and 40 DAE caused greater CCI reduction (42%) than earlier-emerging weeds. Since early emerging weeds are in a better position to intercept light, it can be said that they would have higher CCI more than that of late emerging weeds.

Table 1: Mean comparison of lamb's-quarters emergence time on it's leaf area index and leaves chlorophyll content index at interference with marigold

Weed emergence time (DAE)	0	10	20	30	40
Leaf area index	0.84 a	0.66 b	0.66 b	0.37 c	0.28 c
Chlorophyll content index	27.8 a	25.7 a	21.4 b	16.0	16.4

Values within rows followed by the same letter have no significant difference at the 0.01 probability level.

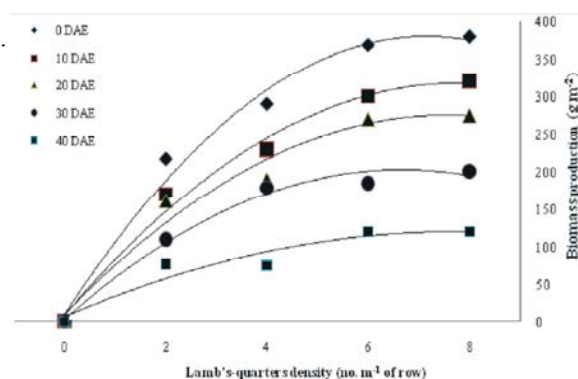


Fig. 1: Lambs-Quarters biomass production as a function of its density at various times of emergence relative to marigold

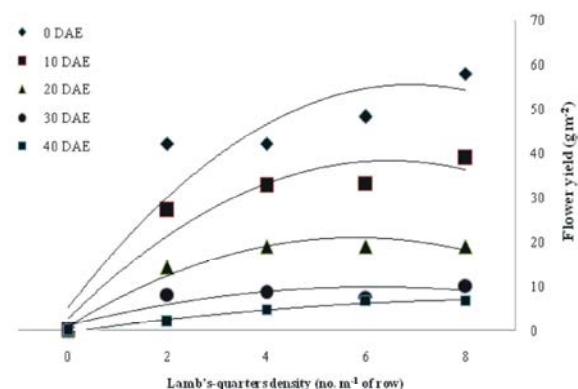


Fig. 2: Marigold dry flower yield loss a function of lambs-quarters density at various times of emergence relative to marigold

When 2, 4, 6 and 8 weed plants emerged in marigold field, they produced 147, 192.8, 248.8 and 259.4 g m⁻² dry matter, respectively. But when lamb's-quarters plants emerged along with marigold, or 10, 20, 30 and 40 DAE, they produced 251, 204, 179, 135 and 78 g m⁻² dry matter, respectively (Fig. 1). In this experiment, weed emergence time was more effective than it's density on weed dry matter. For example, dry matter production in emergence of 6 lamb's-quarters plants per meter row along with the crop (369 g m⁻²) and 10, 20 and 30 DAE (300, 270 and 185 g m⁻², respectively) were more greater than emergence of 8 lamb's-quarters plants per meter row at 10, 20, 30 and 40 DAE (321, 275, 201 and 120 g m⁻², respectively) (Fig. 1).

In an experiment conducted by Valizadeh and Mirshekari [6] redroot pigweed biomass reduced when duration of interference decreased.

Lamb's-quarters seedlings that emerged along with marigold caused greater crop flower yield reduction than later-emerging weeds at similar densities. For example, 6 or 8 lamb's-quarters m^{-1} emerging along with the crop resulted in an average of 53% yield loss as compared to 7% for emergence at the 40 DAE (Fig. 2). Our trial suggests that weeds emerging several days after that of marigold may have a minimal adverse impact on yield even when present at high densities. Since early emerging weeds are in a better position to have moisture, nutrients and light, it can be said that they affect crop yield more than that of late emerging weeds. Therefore, lamb's-quarters emergence time, against that of marigold is more critical than weed density, to affect marigold flower yield. This is in conformity with results obtained from other studies like the competition of barnyard grass with corn [10], wild radish with canola [11] and red root pigweed with sugar beet [12].

On the base of regression analysis results attributes as weed biomass production and its leaf area index could explain 81.3% of marigold flower yield changes and high R^2 showed that these attributes had high effects on crop flower yield.

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