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CROP PROTECTION

RESEARCH PAPER

Fresh matter production by two forms of *Oxalis latifolia* as influenced by soil and climate

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Abstract

A. Royo-Esnal and M.L. López. 2012. Fresh matter production by two forms of *Oxalis latifolia* as influenced by soil and climate. Cien. Inv. Agr. 39(2): 309-320. *Oxalis latifolia* is a widely distributed weed that mainly affects corn fields, orchards, plant nurseries and gardens. Two forms of the weed have been identified: the common form, with fish-tailed leaflets, bulbils growing on stolons and dark pink flowers, and the Cornwall form, with rounder leaflets, sessile bulbils and whitish-pale pink flowers. In this study, the fresh matter production, expressed as the increase of the bulbs' fresh weight, of both forms was compared during two growing seasons in two locations. The bulbs were grown in pots from spring to autumn, and different aspects of growth were measured at the end of each season. The total fresh matter production, weight of the apical bulb, total weight of the lateral bulbs and number of lateral bulbs differed between the forms, but the mean weight of the lateral bulbs did not. The production of fresh matter was related mainly to the climatic conditions, with both forms of *O. latifolia* being sensitive to excess rainfall (*e.g.*, > 100 mm) in June and July. The two forms of *O. latifolia* differed with respect to the fresh matter allocation to the apical or lateral bulbs, suggesting a difference in their growth strategies. The common form developed a light apical bulb and devoted more resources to the lateral bulbs, whereas the Cornwall form developed a heavy apical bulb and many comparatively smaller lateral bulbs. Despite their relative indifference to the soil type, the differences between the two forms suggest that they originated from different climatic regions and that they may differ in their invasive abilities.

Key words: Bulb, climate, *Oxalis,* soil conditions, weed.

Introduction

Oxalis is one of the most invading plant genera; 34 species are considered invasive, and the genus ranks 15th on the list of 126 invasive plant genera (Heywood, 1996), with *Oxalis latifolia* ranked as one of the world's worst weeds (Holm *et al*., 1997). The weed is troublesome in tropical, temperate and Mediterranean climates, including 37 countries, and has been reported to invade 30 different crops (Holm *et al.,* 1997), causing yield losses in turnip (Chivinge and Rukuni, 1989), cotton (Wilkins and

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Kabanyoro, 1997), potato (Nimje, 1988), soybean (Arya *et al.,* 1994), apple (Seth *et al.* 1982) and maize (Atwal and Gopal, 1972). Yield losses mainly occur when the growth of the weed coincides with the early growth of the crop (Church and Henson, 1969). Occasionally, the yield losses are considered insignificant (Thomas, 1991), or the presence of *O. latifolia* is considered positive, *i.e.*, when it protects the soil from erosion and competes with other weeds that are considered more harmful to the crop (Oshawa, 1982). Figure 1 represents the distribution of *O. latifolia* throughout the Iberian Peninsula according to Flora Ibérica (2010) and the Anthos project (2010). It can be observed that the weed is more frequent in Northern Spain, where it mainly invades maize fields, vegetable orchards and urban and residential gardens (Royo-Esnal and López, 2008a).

Although *O. latifolia* is of a tropical origin, this species can grow and survive well outside the tropics (Royo-Esnal and López, 2008b). Referring to the aerial part of the weed, Jackson (1960) stated that it grows in summer and dies in winter. Chawdhry (1974) is more specific and clarifies that *O. latifolia* remains dormant during the winter in temperate climates. Two conditions are required for *O. latifolia* growth and survival outside of the tropics: 1) frost-free conditions in the subsoil (Jehlik, 1995; Royo and López, 2004) and 2) sufficient moisture during the summer (Royo-Esnal and López, 2008b; Royo-Esnal and López, 2005). These two conditions explain why *O. latifolia* is found in oceanic and Mediterranean irrigated crops, such as maize.

O. latifolia is adapted to highly disturbed fields, is associated with high nutrient levels (Ugen and Wortmann, 2001) and has been classified as nitrophilic and hemerophytic (Jehlik, 1995). It can grow in medium- and heavy-textured soils (Holm *et al*., 1997) and in light-textured and low organic matter soils. In its natural distribution area, *O. latifolia* also grows in disturbed areas, such as mountaintops and quarries, and it prefers clay and stony soils (Jehlik, 1995).

Young (1958) identified two forms of *O. latifolia*: a typical form and another form that is common in Cornwall and Devon (UK). The two forms can be separated morphologically, as the typical form has leaflets that are fish-tail shaped, develops bulbs on stolons and produces dark pink flowers. In contrast, the form that is found in Devon and Cornwall has rounder leaflets, develops sessile bulbs and produces whitish-pale pink flowers (Young, 1958). Esler (1962) added the mid-styled form, and the description of the morphology resembles *O. debilis* (= *O. corymbosa*) with which *O. latifolia* is often confused. López and Royo (2002) found that the Devon and Cornwall form (called "Cornwall") had higher levels of productivity

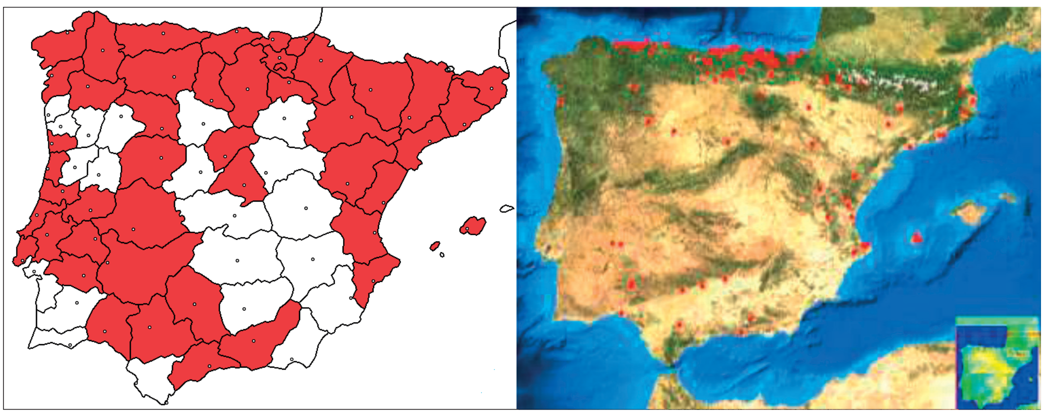

Figure 1. Left, the red areas indicate locations where *O. latifolia* has been observed in the Iberian Peninsula, according to Flora Ibérica (2010). Right, the distribution of *O. latifolia* throughout the Iberian Peninsula (except Portugal), according to the Anthos project (information system about plants in Spain).

(biomass and number of bulbs) than the typical form (called "common"); these authors found additional morphological and anatomical differences between the two forms (López and Royo, 2003a; Royo and López, 2005), and Royo-Esnal (2007) proposed that the Cornwall form might actually be the rare species *O. jacquiana* (Kunth, 1821).

Although the differences found in previous studies may indicate different ecological adaptations in the original distribution area, both forms of *O. latifolia* may appear in the same crop (López and Royo, 2003b), even when only one of them is usually present. Further studies on the effects of the climate and soil characteristics could help identify which factors most affect the growth of the *O. latifolia* forms and, thus, may aid in 1) the knowledge of the real taxonomical relationship between the common and Cornwall forms of the weed and 2) the identification of new ways to control the weed, which might be different for each form of *O. latifolia*.

Accordingly, the fresh matter production of the common and Cornwall forms was compared with regard to the influences of the season and the nutritional status of the soil.

Materials and methods

An experiment was conducted in a plant nursery in Hernani, Northern Spain, during 2001. In 2002, the experiment was replicated in the same location (Hernani) and in an orchard in Azkoitia, 60 km from Hernani. The treatments consisted of combinations of the common or Cornwall forms of *O. latifolia* and rich or poor soils. A total of twelve 7.6 L pots (0.225 m x 0.225 m x 0.15 m) with four drainage holes at the bottom were filled with either a sandy clay loam soil ('rich'; 2.15 % organic matter (OM), pH 7.84) or a silty clay loam soil ('poor'; 0.82 % OM, pH 8.3).

Oxalis latifolia bulbs were collected during the winter in an orchard 6 km away from Hernani (Northern Spain) that was infested by both the common and Cornwall types, and the bulbs were washed and dried. Based on the morphological characteristics described by López and Royo (2003a), the bulbs of each form were separated as follows: whitish scales with three prominent nerves in the common form and yellowish scales with one non-prominent nerve in the Cornwall form. Bulbs with root formation and an initial weight (IW) between 0.300 and 0.450 g were selected. In April, 10 bulbs of each form were planted at 1 cm depths in pots with either rich (n = 5) or poor soil (n = 5). The bulbs were planted at least 5 cm from each other and from the pot edge. The pots were placed in the field, half buried in the soil, without irrigation and remained exposed to the prevailing weather conditions. For each year and location, the design was a split plot with three replications. Weeds other than *O. latifolia* were removed by hand at weekly intervals. The coding for the different treatments was as follows: common form in rich soil, M1; common form in poor soil, M2; Cornwall form in rich soil, R1; and Cornwall form in poor soil, R2.

To assess the variability of the fresh matter, prior to the experiment, 50 apical bulbs and 50 lateral bulbs were weighed fresh and then dried, and the water content between both forms was compared. There was no significant difference between the bulbs (47.2 and 42.8% for the common and Cornwall forms, respectively).

The bulbs were harvested in October, washed, dried and stored until further processing in the laboratory. The weights of the new apical bulb (AW) and lateral bulbs (LW) and the number of lateral bulbs (LN) were determined. The fresh weight production (PRO) was estimated as the increase in weight relative to the weight of the initial bulb (IW) and expressed as a percentage:

$$PRO = (AW + LW - IW) / IW \times 100\%$$

The ratio between the weight and number of lateral bulbs (LW/LN) was considered as the mean weight of the lateral bulbs (LMW). The ratio between the weights of the lateral bulbs and apical bulb (LW/AW) was also calculated to study the priority of each form when developing the apical and the lateral bulbs.

Characterization of the climatic conditions in 2001 and 2002

Based on the theories of Rivas-Martínez (2007), the climatic conditions were calculated by relating the precipitation and temperature (ombrothermic index, *Io*). These climatic conditions were obtained only for those months when the growth of *O. latifolia* is important (May-August). The values of *Io* for May, June, July and August:

$$Io_{may} = P_{may}/T_{may}$$
$$Io_{june} = P_{june}/T_{june}$$
$$Io_{july} = P_{july}/T_{july}$$
$$Io_{august} = P_{august}/T_{august}$$

and *Ios2*, *Ios3* and *Ios4*

$$Io2 = (P_{june}+P_{july})/(T_{june}+T_{july})$$
$$Io3 = (P_{june}+P_{july}+P_{august})/(T_{june}+T_{july}+T_{august})$$
$$Io4 = (P_{may}\ P_{june}+P_{july}+P_{august})/(T_{may}+T_{june}+T_{july}+T_{august})$$

were used to evaluate their effect on the different parameters measured. The meteorological data were obtained from the Spanish National Meteorological Institute (INM).

Statistical analysis

Fresh matter production (PRO) data were ln(x+101) transformed to conform to the conditions of normality. The number 101 was included in the transformation because negative fresh matter production (loss of fresh matter) was encountered. The transformed data were subjected to a three-way ANOVA, with the *O. latifolia* form (common or Cornwall), soil condition (rich or poor) and season (2001 or 2002) as the main factors. Tukey's test was used as a post hoc test to identify significant differences in the PRO between the forms, seasons and soil conditions.

Similarly, the effects of the soil conditions and season were analyzed using a three-way ANOVA for each separate component of fresh matter production (AW, LW, LN, LMW and AW/LW), previous to the ln(x+1) transformation of the data.

The presence of interactions between the factors forced us to perform a T test for paired comparisons (Field, 2000) to analyze the differences in the fresh matter production variables between the forms. Once differences between the forms for almost all of the variables were demonstrated, the effect of the soil and season were analyzed for each form using two-way ANOVAs and Tukey post hoc tests. Moreover, several Pearson correlations were performed to identify any relationship between these parameters and the soil and climate characteristics. The Pearson correlation analysis is a linear equation that suggests that there is a correlation between parameters, yet significant correlations might appear that are not necessarily linear. Furthermore, the characteristics of the data in this study (two types of soil and three growing seasons) only permit the clarification of tendencies rather than the proposal of real formulae. To evaluate the correlations, the variables were converted to a percentage when the soil values were analyzed, taking the highest value of each form as reference. When the climate was analyzed, the same criterion was followed, but the three years for each form and soil type were separated.

All analysis were conducted using the software SPSS 11.0 and SPSS 15.0 for Windows (SPSS Inc., Chicago IL, USA).

Results

The fresh weight production of the Cornwall form was significantly greater than that of the common form, regardless of the soil conditions or season (Figure 2). Similarly, the AW, LW and LN values were higher for Cornwall than the common form in all cases (Figure 3). Specifically, the apical and all lateral bulbs (considered together) were heavier, and the lateral bulbs were more numerous for the Cornwall form than the common form. However, such differences were not observed with regard to the LMW (Figure 3D), which, in general, did not present significant differences between the forms, which was heavier for the common form (M2 in 2002b) and the Cornwall form (R1 and R2 in 2001) at different times.

The LW/AW ratio illustrates the distribution of resources among the lateral and apical bulbs (Figure 4) and was always significantly greater for the common form than for the Cornwall form of *O. latifolia* (P≤0.01), except in 2002b under poor soil conditions.

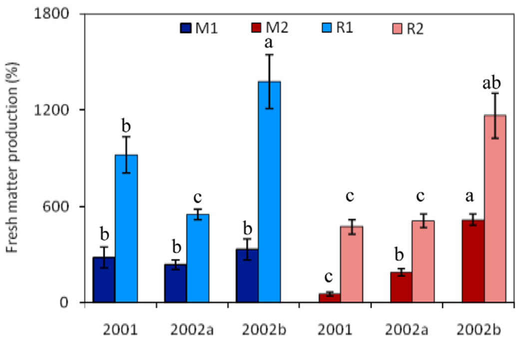

Figure 2. *Oxalis latifolia*: mean productivity results (with error bars) for the M1, M2, R1 and R2 treatments. Blue color, rich soil; red color, poor soil. Different letters indicate significant differences (Tukey; P≤0.01) among the treatments for each form.

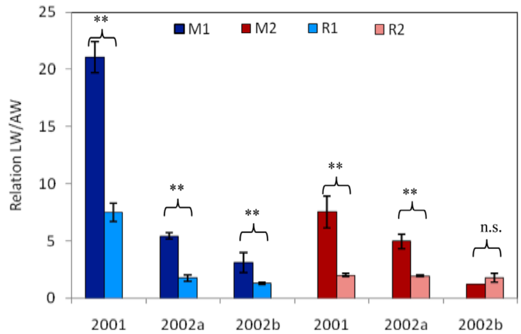

Figure 4. Mean results for the lateral bulb of *Oxalis latifolia* mean weight (with error bars) for M1, M2, R1 and R2. Blue color, rich soil; red color, poor soil. **for significant differences; n.s., for non-significant differences (P≤0.01).

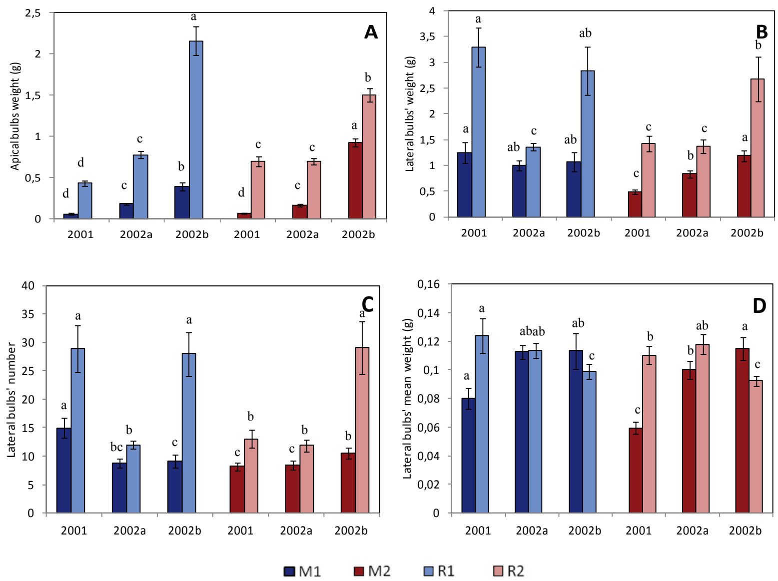

Figure 3. *Oxalis latifolia*: Mean results for the apical bulb weight (A), lateral bulb weight (B), lateral bulb number (C) and lateral bulb mean weight (D) (with error bars) for M1, M2, R1 and R2. Blue color, rich soil; red color, poor soil. Different letters indicate significant differences (Tukey; P≤0.01) among the treatments for each form.

Correlations between soil and climate factors and fresh matter production variables

The Pearson correlation applied to analyze the effect of the soil type showed that there was a significant negative correlation for the rich and poor soil in 2001 and both forms for almost all of the variables (Figures 5 and 6). That is, the productivity and most of the variables decreased in the poor soil. The common form in 2002b also showed significant positive relations for the PRO and AW with the soil type, increasing their values in poor soil (Figures 5A and 5C). Neither the common form in 2002a nor the Cornwall form in 2002a and 2002b showed any significant correlation for any of the considered parameters (Figures 5 and 6). The LMW did not show any correlation with either form or any season (Figures 6C and 6D).

Regarding the effect of the season factors, Figure 7 shows the *Io* calculated for each month of each year. The Pearson correlation showed that *Ios2* was the most significant factor (P≤0.01), determining the PRO for the common form in the poor soil (M2) and the Cornwall form (R1 and R2 for the rich and poor soil, respectively) (Table 1); *Ios2* was also the most important factor, though not significant for the common form in the rich soil (M1) (P=0.073). The breakdown of *Ios2* indicated it as the most important factor for the poor soil *Io* of July (negatively correlated).

With respect to the fresh matter production variables, the AW was very significantly related to *Ios2* in the M2, R1 and R2 treatments (P≤0.01), and significantly in M1 (P≤0.05) (Table 2). Again, the *Io* of July was significantly and negatively

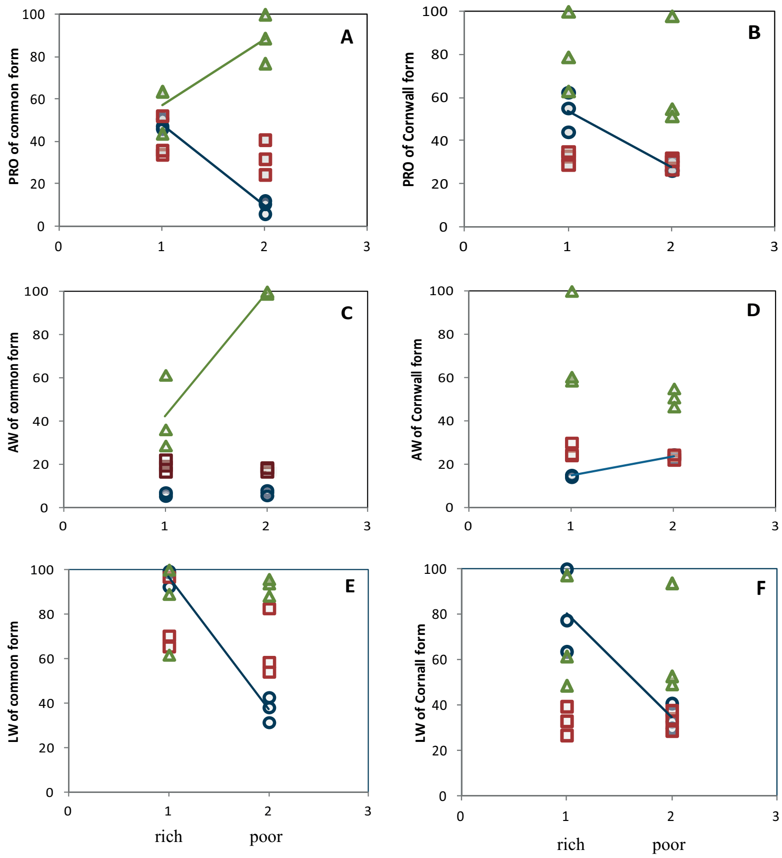

Figure 5. Pearson correlation between the soil type and the PRO, AW and LW for the common (A, C, E) and Cornwall (B, D, F) forms of Oxalis latifolia.

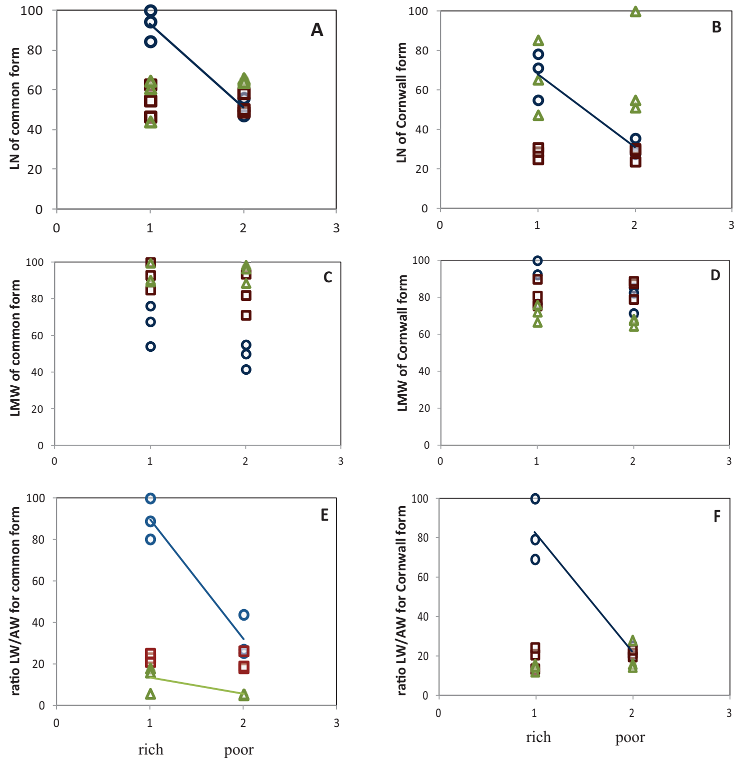

Figure 6. Pearson correlation between the soil type and the LN, LMW and LW/AW ratio for the common (A, C, E) and Cornwall (B, D, F) forms of Oxalis latifolia.

correlated with the weight of the apical bulb. The LW is influenced mainly by the *Io* of July and *Ios2* for M2 and R2 and *Ios4* and the *Io* of June for R1, whereas there was no observed any correlation for M1 for the LW (Table 2). The LN was positively correlated with the *Io* of July for M1, whereas it was negatively correlated with the *Io* of August. In the M2 and R2 treatments, *Ios2* and the *Io* of July were negatively correlated with the LN. For R1, the LN was negatively correlated with *Ios3*, *Ios4* and, particularly, the *Io* of June. For the common form, the LMW was significantly and positively correlated with the *Io* of May and

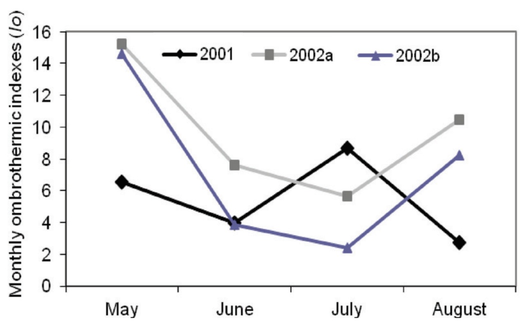

Figure 7. Oxalis latifolia: Ombrothermic indexes for May, June, July and August of 2001, 2002a and 2002b. *Io* is the relationship between the rainfall and temperature when the latter is higher than 0 ºC (*Io*=Pi/Ti).

Table 1. Pearson correlation for the fresh matter production (PRO) between the climatic parameters M1, M2, R1 and R2. Significant correlations are indicated with asterisks.

Form/soil	*Ios*may	*Ios*jun	*Ios*jul	*Ios*aug	*Ios2*	*Ios3*	*Ios4*
M1	-0.007	-0.575	-0.384	-0.151	-0.624	-0.586	-0.404
M2	0.662	-0.249	-0.956**	0.493	-0.921**	-0.279	0.112
R1	-0.004	-0.755*	-0.510	-0.195	-0.824**	-0.770*	-0.529
R2	0.402	-0.396	-0.748*	0.238	-0.828**	-0.419	-0.103

*significant at P≤0.05; **significant at P≤0.01.

August but negatively correlated with the *Io* of July. The *Io* of July for R1 and *Ios2* for R2 were also positively correlated with the LMW (Table 2).

Lastly, the LW/AW ratio is positively correlated with the *Ios* of July for the M1, M2 and R1 treatments and negatively with the *Ios* of August for M1 and R1. No correlations for this parameter were found for R2 (Table 3).

Discussion

Similar to the observations of Verdaguer *et al.* (2010) for *O. pes-caprae*, the reproductive capacity of *O. latifolia* remains very high, regardless of the soil type or climatic conditions studied. The smallest numbers of lateral bulbs were 9 and 12 and the largest were 15 and 29 for the common and Cornwall forms, respectively, a result that is in accordance with its invasive capacity and classification as a weed. However, Royo-Esnal and López (2005) also observed that the bulbs of both forms are not capable of surviving in climates in which the value of the ombrothermic index (*Io*) of June is approximately one. Thus, as a summer-growing weed, *O. latifolia* is unlikely to spread in Mediterranean climatic areas without any anthropic influence. Accordingly, the propagation of *O. latifolia*

Table 2. Pearson correlation for the apical bulb weight (AW) and lateral bulb weight (LW) between the climatic parameters and M1, M2, R1 and R2. Significant correlations are indicated with asterisks.

	*Ios*may	*Ios*jun	*Ios*jul	*Ios*aug	*Ios*2	*Ios*3	*Ios*4
AW							
M1	0.644	-0.150	-0.867**	0.503	-0.794*	-0.177	0.174
M2	0.536	-0.421	-0.923**	0.344	-0.985**	-0.449	-0.062
R1	0.551	-0.361	-0.870**	0.383	-0.886**	-0.343	0.017
R2	0.435	-0.510	-0.864**	0.236	-0.985**	-0.573	-0.168
LW							
M1	-0.531	-0.399	0.358	-0.547	0.082	-0.387	-0.508
M2	0.785*	-0.016	-0.943**	0.655	-0.786*	-0.046	0.328
R1	-0.585	-0.779*	0.164	-0.689*	-0.281	-0.772*	-0.797*
R2	0.322	-0.417	-0.666*	0.165	-0.772*	-0.437	-0.152
LN							
M1	-0.922**	-0.481	0.767*	-0.896**	0.375	-0.456	-0.734*
M2	0.477	-0.375	-0.822**	0.306	-0.877**	-0.400	-0.056
R1	-0.516	-0.862**	0.022	-0.650	-0.443	-0.860**	-0.824**
R2	0.316	-0.465	-0.691*	0.147	-0.818**	-0.486	-0.188
LMW							
M1	0.877**	0.414	-0.759*	0.842**	-0.404	0.390	0.668*
M2	0.895**	0.228	-0.907**	0.810**	-0.625	0.199	0.546
R1	-0.567	0.082	0.730*	-0.456	0.645	0.105	-0.188
R2	-0,145	0.642	0.610	0.041	0.846**	0.660	0.385

*significant at P≤0.05; **significant at P≤0.01.

Table 3. Pearson correlation for the ratio between the lateral bulb weight and apical bulb weight (LW/AW) between the climatic parameters and M1, M2, R1 and R2. Significant correlations are highlighted in bold.

Form/soil	*Ios*may	*Ios*jun	*Ios*jul	*Ios*aug	*Ios*2	*Ios*3	*Ios*4
M1	-0.970**	-0.373	0.897**	-0.909**	0.540	-0.344	-0.679*
M2	-0.694*	0.110	0.899**	-0.555	0.799**	0.138	-0.224
R1	-0.960**	-0.409	0.862**	-0.911**	0.491	-0.381	-0.701*
R2	-0.178	0.088	0.271	-0.127	0.270	0.096	-0.016

*significant at P≤0.05; **significant at P≤0.01.

in the Mediterranean regions of Spain occurs via irrigated areas, such as maize fields and gardens.

Differences between the common and Cornwall forms

As reported by López and Royo (2002), the fresh matter production of the Cornwall form was much greater than that of the common form in all situations, results that were accompanied by higher values of AW, LW and LN; conversely, the LMW was higher, similar or lower in the common form, depending on the growing conditions. The LW/AW ratio showed that the common form developed apical bulbs and devoted more assimilates to the development of lateral bulbs, whereas the Cornwall form developed a heavy apical bulb and many comparatively smaller lateral bulbs. López and Royo (2003b) observed that the common form was better adapted to less-disturbed soils (maize), whereas both forms were present in more frequently disturbed soils (vegetables), with the Cornwall form being more abundant. Together with the differences observed in this study, these results indicate that both forms have different growing strategies that could have been derived from origins of different climates and levels of soil disturbance.

Correlation of fresh matter production variables with soil and climatic conditions

The decrease of the productivity (and its variables) in both forms in 2001, the increase of productivity in the common form in 2002b and the lack of any other correlation in 2002a and 2002b suggest a low importance of the soil type for the development of the *O. latifolia* forms. Literature regarding the type of soil in which *O. latifolia* can grow (Jehlik, 1995; Holm *et al.,* 1997; Ugen and Wortmann, 2001) also suggest that the range would be wide and would explain the higher levels of fresh matter production found in the poor soil than rich soil in 2002b. In fact, the different responses of the common form indicate that the climatic conditions are much more important for the production of fresh matter and development than the soil itself.

The humidity requirement of *O. latifolia* during the summer and the results obtained by Royo-Esnal and López (2005), in which all of the bulbs died after a drought in June and July 2001 (*Ios2* = 1.1), indicate that a greater amount of precipitation would increase the productivity of any form of this weed. However, the opposite was observed: the greatest correlation values for the PRO were obtained with *Ios2* and the *Io* of July (Table 2), but these were negative. Therefore, an excessive amount of precipitation during June and July is counterproductive. The highest values of PRO were obtained with an *Ios2* = 3.1 and a rich soil. An increase of *Ios2* to 6.3 caused a decrease of the PRO for the common and Cornwall forms of 16% and 33%, respectively, in the rich soil, whereas this decrease reached 73% and 56 % in the poor soil, respectively (Figure 1). Thus, considering the data of Royo-Esnal and López (2005), a gradient of *Ios2* could be established for the PRO: 1.1(†)<3.1>6.3. This finding reveals that June and July are the crucial months for the development of *O. latifolia*. The gradient would also be valid for the AW, which was highly and negatively affected by *Ios2* and the *Io* of July. Similarly, but not so clearly, the values of LW and LN decrease with an increase of the *Io*.

With regard to the LMW, an increase of the *Io* of July decreased the weight for the common form, whereas an increase of the *Ios* of May and August favored an increase in weight. In the Mediterranean region, the photosynthesis, assimilation and leaf development of *O. latifolia* are greatest in August (Royo, 2004). Therefore, rainfall during August is more important because there is a greater demand for water. Again, a harmful effect of heavy rains in July was observed. For the Cornwall form, few correlations were obtained, and these were mainly positive with regard to the *Io* of July (R1) and *Ios2* (R2). Previous studies show that, although the PRO and LN values decreased with burial depth, the LMW remained constant (Royo-Esnal and López, 2007). This tendency to maintain the size (and biomass) of the offspring while other variables change also occurs in other species, such as *Allium vineale* (Ronheim and Bever, 2000). Thus, the lower effect of external factors on the LMW and the lack of correlation between the fresh matter production and the mean weight of the lateral bulbs for the Cornwall form is confirmed.

Lastly, with the exception of the Cornwall form in poor soil, the increase of the *Io* of July results in the parent bulb allocating more assimilate to the lateral bulbs rather than the apical bulb. In addition, the *Io* of August (in rich soil) provokes an increase in allocation to the apical bulb rather than the lateral bulbs. The negative conditions for the general growth of the bulbs causes in the increase of the LW/AW ratio; that is, when the growing conditions are less than optimal, the bulbs attempt to favor the lateral bulbs at the expense of the biomass of the apical bulb. However, when the growth conditions are good (i.e., *Io2* = 3), *O. latifolia* develops a large apical bulb, which can be as heavy as ½ of the total weight of the lateral bulbs.

In summary, the growth and productivity of both forms appear to be more dependent on the climatic conditions than the soil conditions, which are not as important as our original hypothesis. This observation emphasizes the invasiveness of the species. In general, excessive rainfall events, as evaluated as an increase of the ombrothermic index (*Io*), cause a decrease of the fresh matter production variables of *O. latifolia* bulbs. With regard to the productivity and weight of the apical bulb, July seems to be the key month for development in Spain. In contrast, the mean weight of the lateral bulbs is maintained relatively constant for the Cornwall form and is favored by precipitation in May and August and, consequently, by the *Ios* of these months for the common form. Finally, the difference in fresh matter production could indicate a greater invasive ability of the Cornwall form. The Cornwall form also obtained higher values of apical bulb biomass and the biomass and number of lateral bulbs compared to the common form. Furthermore, the LW/AW ratio revealed different growth strategies of the two *O. latifolia* forms.

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Resumen

A. Royo-Esnal y M.L. López. 2012. Producción de materia fresca en dos formas de *Oxalis latifolia*, influida por el suelo y el clima. Cien. Inv. Agr. 39(2): 309-320. *Oxalis latifolia* es una mala hierba de distribución mundial que infesta maizales, huertas, viveros y jardines. Se conocen dos formas de la especie: common, con folíolos bilobulados en forma de cola de pez, bulbillos sobre estolones y flores rosa oscuro; y Cornwall, con folíolos más redondeados, bulbillos sésiles y flores blanquecinas o rosa pálido. El presente estudio compara la producción de materia fresca, expresada como el incremento del peso fresco de los bulbos, de ambas formas durante dos temporadas de crecimiento en dos localidades. Los bulbos crecieron en macetas de primavera a otoño. En octubre se midieron diferentes aspectos del crecimiento. La producción total de peso fresco, el peso del bulbo apical, el peso total de los bulbos laterales y su número fueron desiguales en una y otra forma, pero no así el peso medio de los bulbos laterales. La producción en peso fresco pudo ser relacionada con las condiciones climáticas.

En ambas formas, la producción de peso fresco es sensible al exceso de precipitación (*e.g.* > 100 mm) de Junio y Julio, pero difirieron en la alocación de la materia fresca, lo que sugiere una diferencia en cuanto a la estrategia de crecimiento: La forma common desarrolla bulbos apicales ligeros y destina mayor esfuerzo a los bulbos laterales, mientras que la forma Cornwall desarrolla bulbos apicales pesados y comparativamente menores bulbos laterales. A pesar de la relativa indiferencia al tipo de suelo, las diferencias encontradas entre las dos formas sugieren una procedencia climática distinta, así como una capacidad invasiva dispar.

Palabras clave: Bulbo, clima, condiciones de suelo, mala hierba, *Oxalis*.

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