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Effects of amino acids and irrigation interrupted on some characteristics in flixweld (*Descurainia sophia* L.)

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Abstract— **Drought stress signal transduction consists of ionic and osmotic homeostasis signaling pathways, detoxification (i.e., damage control and repair) response pathways, and pathways for growth regulation. In order to the effects of amino acids and irrigation interrupted on some characteristics in flixweld (*Descurainia sophia* L.), this experiment was carried out using by a split plot design with four replications at Iran in 2010. The factors including irrigation regimes (irrigation interrupted from flowering stage, irrigation interrupted from silique formation stage and irrigation interrupted from seed filling stage) in main plots and commercial amino acids (Aminol-Forte, Hyomi-Forte, Kadostim and Phosnotron) that sprayed in three stages (25, 50 and 75 days after germination) in subplots were studied. The results showed that amino acid and irrigation regimes were significant effects on physiological and morphological features under field condition. The means compression obtained that highest stem diameter, shoot/root, plant height and essential oil content were achieved by Kadostim under irrigation interrupted from seed filling stage. The results of this experiment indicated that drought stress was reduced the physiological and morphological features of flixweld sorely.**

Keywords-drought stress; amino acid; physiological and morphological features; flixweld

I. INTRODUCTION

Drought resistance refers to a plant's ability to grow and reproduce satisfactorily under drought conditions, and drought acclimation refers to a plant's ability to slowly modify its structure and function so that it can better tolerate drought (Turner, 1986). Drought stress is one of the most important environmental stresses affecting agricultural productivity around the world and may result in considerable yield reductions (Boyer, 1982; Ludlow and Muchow, 1990). Apart from the effect of drying soil on the transport of nutrients to plant roots, the morphological and physiological mechanisms involved in cellular and whole plant responses to water stress are of considerable interest and are frequently examined (Neumann, 1995). The effect of water stress on essential oil was studied in excised leaves of palmarosa (*Cymbopogon martinii* var. motia) and citronella java (*C. winterianus*). Essential oil percentage increased under water stress and essential oil content decreased under this condition (Fatima et al., 2006). Also, Khalid (2006) evaluated the influence of water stress on essential oil of two species of an herb plant ie *Ocimum basilicum* L. (sweet basil) and *Ocimum americanum* L. (American Basil). For both species under water stress, essential oil percentage and the main constituents of essential oil increased. Seventy five percent field water capacities resulted in the highest yield of herb and essential oil for both species. Also, water stress had significant affected on flowering shoot yield, essential oil yield of flowering shoot and essential oil percentage of flowering shoot of coriander and highest upon characteristics were achieved under without stress conditions and highest oil percentage of flowering shoot was achieved under water stress conditions (Aliabadi Farahani et al., 2008). In the study of chicory showed that drought stress significantly increased the essential oil percentage and reduced kaempferol content of chicory. Although the non-drought stress treatment significantly increased essential oil content of plants (Taheri Asghari et al., 2008). Flixweld tansy mustard is native to Europe and northern Africa (Thomas, 1991). It probably arrived in North America in the mid-1800s as an impurity in crop seed, and was widespread by the 1920s (Pyke, 2000). It now occurs in 48 states, excluding Alabama and Florida (Kartesz et al., 1999). Its distribution extends south to Baja California, and as far north as 70^o N latitude in Greenland, Alaska, and Canada. It occurs throughout Canada except Labrador and eastern Nunavut (Hulten, 1968). Plants database provides a distributional map of flixweld tansy mustard in the United States and Canada. Flixweld tansy mustard is also introduced in South America, Asia, southern Africa, and New Zealand (Mitich, 2002). The following biogeographic classification systems are presented as a guide to demonstrate where flixweld tansy mustard may be found. Precise distribution information is limited. Because it is so widespread, it is difficult to exclude many ecosystems as potential hosts of flixweld tansy mustard plants or populations. Flixweld tansy mustard grows in a broad spectrum of environments ranging from cold desert, tundra, taiga, alpine, and subalpine ecosystems to hot desert and dry-tropical Hawaiian ecosystems (Keeley et al., 1985). Flixweed tansy mustard is ecologically important in most North American desert ecosystems. In Great Basin Desert communities of east-central Nevada, it showed 25-40% frequency in big sagebrush (*Artemisia tridentata*) communities and 5-66% frequency in singleleaf pinyon-Utah juniper (*Pinus monophylla-Juniperus osteosperma*) communities (On the Desert Tortoise Research Natural Area in the Mojave Desert, southern California, flixweed tansymustard associates with creosotebush (*Larrea tridentata*), white bursage (*Ambrosia dumosa*), and other annuals, the most common being cutleaf filaree (*Erodium *cicutarium*), red brome (*Bromus madritensis* ssp. *rubens*), and Mediterranean grass (*Schismus* spp.) (Brooks, 1998). A few vegetation classifications describe plant communities dominated by flixweld tansy mustard. A flixweld tansy mustard-Russian-thistle (*Salsola kali*) community occurs in Lava Beds National Monument, California, on land with a history of extreme disturbance: 1st by lake drainage, then by cultivation of the lakebed (Erhard, 1979). In east-central Nevada, flixweed tansymustard communities occur on highly disturbed winterfat (*Krascheninnikovia lanata*) habitat types. Halogeton (*Halogeton* glomerata) codominates, and winterfat is present in trace amounts (Evans et al., 1987). The following description of flixweld tansy mustard provides characteristics that may be relevant to fire ecology, and is not meant for identification. Keys for identification are available (Gleason and Cronquist, 1991). Flixweld tansy mustard is an exotic, cool-season annual or biennial. It is the type species for the genus (Heinselman, 1970). The single, 6- to 31-inch-long (15-80 cm) stem is coarse, with basal and cauline leaves. Cauline leaves have a large amount of surface area, being 2 or 3 times pinnately divided. The inflorescence is a raceme of bisexual flowers. The fruit is a 1 × 10- to 71-mm-long silique bearing 10 to 20 small (10-25 mm long), seeds (Stephens, 1980). Tansy mustard (*Descurainia* spp.) fruits and seeds do not have specialized appendages for dispersal (Keeley, 1991). Tansy mustards have a short taproot (Young and Evans, 1981). Stand structure of flixweld tansy mustard-dominated communities is sparse immediately after disturbance. Flixweld tansy mustard stands often become dense and crowded within a few postdisturbance years, and thin as succession advances (Best, 1977). Flixweld tansy mustard establishes from soil-stored seed after fire (Akinsoji, 1988). Animal, wind, or machinery transport from off-site may provide additional, minor sources of seed or introduce flixweld tansy mustard to burns where it is not already present in the soil seed bank. Fire creates conditions favorable for flixweld tansy mustard establishment (bare soil, open canopy, reduced growth interference) (Sapsis, 1990). As a shade-intolerant, invasive species, flixweld tansy mustard thrives in the early postfire environment (Wright et al., 1979). Introduced species can alter the rate of spread of fire, the probability of occurrence of fire, and the intensity of fire in an ecosystem (D'Antonio, 2000). Flixweld tansy mustard has multiple, finely divided leaves (Diggs, 1999) and tends to form dense stands that are dead and dry by the fire season; hence, it provides a source of fine surface fuels that can spread fire. If flixweed tansymustard stands do not burn, they provide litter that favors establishment of species, including cheat-grass, which are more sensitive to desiccation as germinates and seedlings than flixweld tansy mustard (Finney and Martin, 1989). Flixweld tansy mustard was absent or unimportant in fire-prone ecosystems when historic fire regimes were functional; however, pinnate and other tansy mustards were present. Flixweld and pinnate tansy mustard are morphologically and ecologically similar and flixweld tansy mustard is filling or sharing the ecological niche of pinnate tansy mustard as an initial colonizer and early seral species on burns. The role of both species in facilitating establishment of other weedy species in dry environments by providing litter (and subsequently, more mesic conditions for germination and seedling growth of other species including cheatgrass) needs further investigation. There may be subtle differences in the effectiveness of the 2 species in facilitating postdisturbance succession; this also bears investigation, particularly in areas vulnerable to cheat-grass invasion (Nelson et al., 1989).

Amino acids are molecules containing an amine group, a carboxylic acid group and a side chain that varies between different amino acids. These molecules contain the key elements of Carbon, Hydrogen, Oxygen, and Nitrogen. These molecules are particularly important in biochemistry, where this term refers to alpha-amino acids with the general formula $H_2NCHRCOOH$, where R is an organic substituent (Baumann, 1984). In an alpha amino acid, the amino and carboxylate groups are attached to the same carbon atom, which is called the α–carbon. The various alpha amino acids differ in which side chain (R group) is attached to their alpha carbon. These side chains can vary in size from just a hydrogen atom in glycine, to a methyl group in alanine, through to a large heterocyclic group in tryptophan. Amino acids are critical to life, and have many functions in metabolism. One particularly important function is as the building blocks of proteins, which are linear chains of amino acids. Every protein is chemically defined by this primary structure, its unique sequence of amino acid residues, which in turn define the three-dimensional structure of the protein. Just as the letters of the alphabet can be combined to form an almost endless variety of words, amino acids can be linked together in varying sequences to form a vast variety of proteins (Wollaston, 2000). Amino acids are also important in many other biological molecules, such as forming parts of coenzymes, as in S-adenosylmethionine, or as precursors for the biosynthesis of molecules such as heme. Due to this central role in biochemistry, amino acids are very important in nutrition. Amino acids are commonly used in food technology and industry. For example, monosodium glutamate is a common flavor enhancer that gives foods the taste called *umami*. They are also used in industry. Applications include the production of biodegradable plastics, drugs and chiral catalysts (Pisarewicz et al., 2005). Therefore, the objective of this study was to evaluate the effects of Aminol-Forte, Hyomi-Forte, Kadostim and Phosnotron amino acids and water stress on quantity and quality features in flixweld (*Descurainia sophia* L.).

II. MATERIAL and Methods

This experiment was carried out using by a split plot design with four replications at Iran in 2010. The factors including irrigation regimes (irrigation interrupted from flowering stage, irrigation interrupted from silique formation stage and irrigation interrupted from seed filling stage) in main plots and commercial amino acids (Aminol-Forte, Hyomi-Forte, Kadostim and Phosnotron) that sprayed in three stages (25, 50 and 75 days after germination) in subplots were studied. Observed data were subjected to analysis of variance (ANOVA) using Statistical Analysis System and followed by Duncan's multiple range tests.

Terms were considered significant at $P < 0.05$ (SAS institute Cary, USA, 1988).

III. Results and DISCUSSION

The results showed that amino acid and irrigation regimes were significant effects on physiological and morphological features under field condition. The means compression obtained that highest stem diameter, shoot/root, plant height and essential oil content were achieved by Kadostim under irrigation interrupted from seed filling stage (Figures 1 and 2). As it was shown in our results, drought stress had a negative effect on most of the emphasized growth compounds. In contrary, reducing water supply in soil achieved a situation for plant to pursue root growth though soil depth. This shows that in order to resist drought stress, the plant employed different strategies throughout individual survival straggle by drought conditions. In terms of reduce in evaporation plants showed an extreme reduce of leaf length and width (reduction in evaporation area). Although significantly reduction in plant height and tiller number might be due to decreasing of the evaporation area of leaves and it eventually caused of low dry matter at the end of growth period under drought conditions. Those might be correspond to the fact that under drought stress stomata's become blocked or half-blocked and this leads to a decrease in absorbing Co_2 and on the other hand, the plants consume a lot of energy to absorb water, these cause a reduction in producing photosynthetic matters. Our observation indicated with rising increase of drought stress, its biological yield and grain yield decreased with rising of drying in soil. Further reducing of shoot dry weight might be due to the reduction of photosynthesis area in leaf, drop in producing chlorophyll, the rise of the energy consumed by the plant in order to take in water and to increase the density of the protoplasm and to change respiratory paths and the activation of the path of phosphate pentose, or the reduction of the root deploy, etc. Also, the results showed that applications of amino acids increased oil content, because nitrogen, which is a primary constituent of proteins, is extremely susceptible to loss when considering that average recovery rates fall in the range of 20 to 50% for dry matter production systems in plants. Amino acids generally cause deficiency of potassium, increased carbohydrate storage and reduced proteins, alteration in amino acid balance and consequently change in the quality of proteins and are a main element in chlorophyll production. Our study showed that under drought condition, oil content was reduced, while the application of amino acids was contributed to protect root against damaging effects of drought stress by root development and chlorophyll production. Currently the control of drought stress has been paying attentions due to the most important environmental factor in arid and semi –arid regions. Practically, findings may suggest farmers and agricultural researchers to consider carefully on limiting or control the huge among of application of amino acids in suffered soils by water restriction as current challenge of scientist in global changes.

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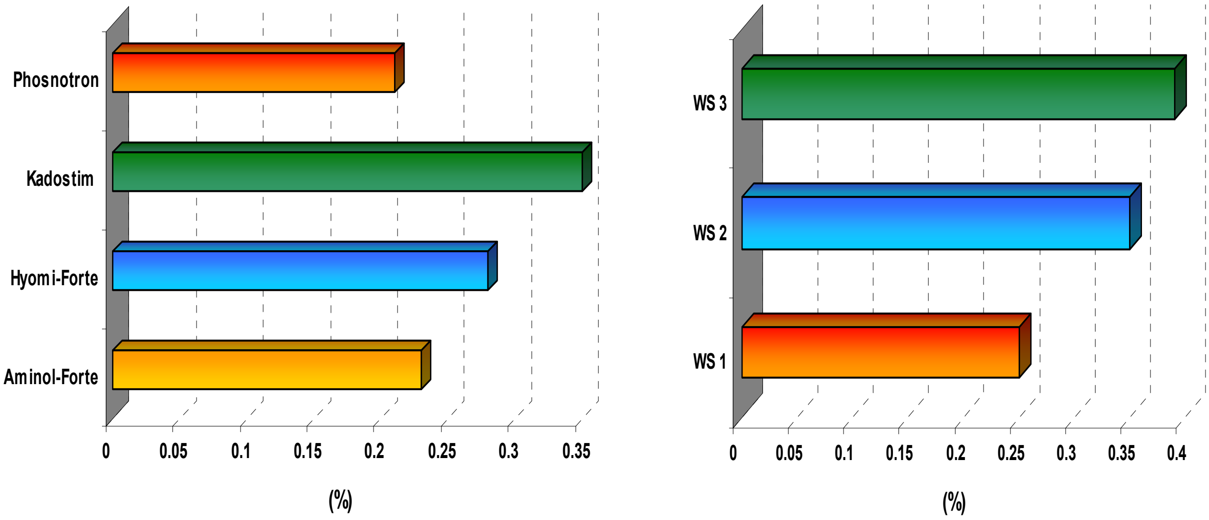

Figure 1. (a) Essential oil content under amino acids application: (b) Essential oil content under irrigation regims.

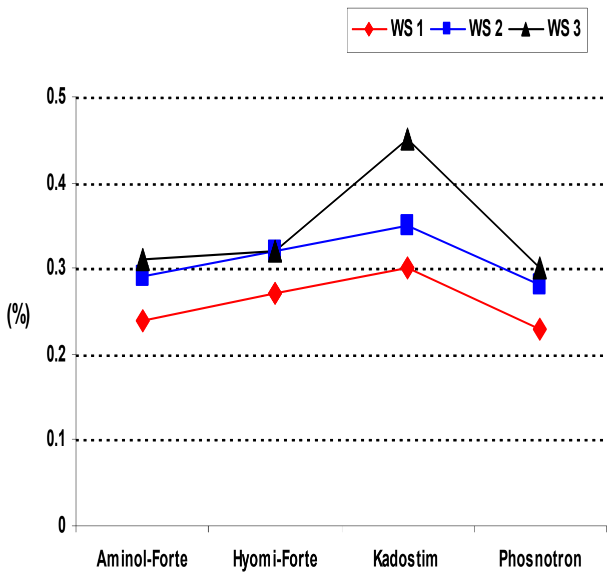

Figure 2. Interaction effect of treatments on essential oil content