Phenological characteristics of the invasive weed *Cucumis melo*

Phänologische Eigenschaften der invasiven Unkrautart Cucumis melo

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Abstract

Phenology is the study of periodic biological events. The time of weed appearance, growth and reproduction are very important for decisions on invasive weed management. *Cucumis melo* is an annual invasive weed of soybean fields in the north of Iran that reproduces and spreads predominately through seed production. In order to study the phenology of wild melon was conducted an experiment in CRD at Research Farm of Gorgan University of Agricultural Sciences and Natural Resources, Iran, during 2012. Seeds first germinated after 10 days of planting, as soon as optimal soil temperatures were achieved. The weed exhibited monoecious tendencies, with production of male flowers rapidly followed by production of both male and female flowers on the same vine. *Cucumis melo* exhibited prolific fruit production, until senescence occurred at 75 and 92 days after establishment. First fruit formation was observed between 40 and 49 days after emergence, depending on temperature. To complete growth cycle, of *Cucumis melo* required about 448 and 733 degree days, respectively for late of May and 8 of June. The weed produced a maximum of 100 fruits/plant, but an average plant typically produced 48 fruits/plant. The seed number and seed weight was on average about 190 seeds/fruit and 0.55 g per 100 seeds, respectively. The results indicated that wild melon could produce a lot of fruits and seeds within a growth period of about 75 and 92 days.

Keywords: Growth, monoecious plants, reproduction, wild melon

Zusammenfassung

Die Phänologie befasst sich mit wiederkehrenden biologischen Abläufen. Auflauf, Wachstum und Samenproduktion invasiver Arten sind wichtig für Bekämpfungsentscheidungen. *Cucumis melo* ist eine einjährige, invasive Unkrautart, die im Norden Irans im Sojabohnenanbau vorkommt und sich vorwiegend durch Samenproduktion vermehrt und ausbreitet. Untersuchungen zur Phänologie dieser Unkrautart wurden 2012 auf der Versuchsstation der Gorgan Universität im Iran durchgeführt. Das Auflaufen erfolgte von Anfang bis Mitte Mai nach Erreichen optimaler Bodentemperaturen. Die Unkrautart zeigte monözische Tendenzen indem sowohl männliche als auch weibliche Blüten an einer Pflanze ausgebildet wurden. *Cucumis melo* zeigt eine starke Fruchtentwicklung bis zum Beginn der Seneszens nach etwa 75 Tagen nach der Keimung. In Abhängigkeit von der Temperatur wurde die erste Fruchtbildung 40 bis 49 Tage nach der Keimung beobachtet. Wachstumszyklus für Ende Mai und 8. Juni abzuschließen, *Cucumis melo* der erforderlichen etwa 448 und 733 Grad-Tagen. Die Unkrautart produzierte maximal 100 Früchte pro Pflanze und im Mittel produzierte eine Pflanze 48 Früchte. Die Samenanzahl und das Samengewicht lagen bei 190 Samen pro Frucht und 0,55 g pro 100 Samen. Die Ergebnisse zeigen, dass wilde Melonenarten innerhalb von 75 Tagen eine hohe Anzahl von Früchten und Samen produzieren können.

Stichwörter: Monoecious Pflanzen, Reproduktion, Wachstum, wilde Melone

Introduction

Invasion is the geographical expansion of a species into an area not previously occupied by that species (VERMEIJ, 1996). Invasive weeds can be non-indigenous and indigenous species that can become overly abundant in a plant community (BOOTH, 2003). Biological processes and characteristics that are most important for weeds to thrive are dependent on reproduction, dispersal, phenology and etc. (BRYSON and CARTER, 2004). Phenology is the study of the seasonal timing of life cycle events (RATHCKE and LACEY, 1985). The timing of emergence, growth and sexual reproduction is highly important for the success of invasive weeds. The phenology of a weed is mediated by the interaction of internal factors with external environmental signals such as temperature, day length or drought (GODY *et al.*, 2009; DINCER *et al.*, 2010). Therefore,

understanding the factors that control phenological variability is crucial for the design of durable weed management practices (DINCER *et al.*, 2010).

Cucumis melo subsp. *agrestis* Naudin is a monoecious, annual, trailing-vine plant of the Cucurbitaceae family. The reproduction of *C. melo* takes place only by seeds. The inedible fruits are berries of spherical to ovoid shape with a very thin mesocarp and a lot of tiny seeds (KOUONON, 2003). There are four species of the Cucurbitaceae family that are invasive weeds in Australia and America (TINGLE and CHANDLER, 2003; WANG *et al.*, 2009; SHAIK *et al.*, 2011). *C. melo* is native to Asia but is aggressively invading soybean fields in the north of Iran. The objective of this study was to quantify the phenological development of *C. melo* in response to variations in temperature. This would be useful for decision support systems helping farmers to manage *C. melo.*

Material and Methods

The experiment was conducted in a completely randomized design with six replications at the Research Farm of Gorgan University of Agricultural Sciences and Natural Resources, Iran, during 2012 growing season. Seeds of wild melon were collected from a soybean field located in Golestan province, north of Iran during August 2011. Six seeds of *Cucumis melo* were sown at a depth of 2 - 3 cm on 23 May and 8 June in 3×4 m^2 plots and each plot considered as a replication. Phenological characteristics of wild melon seedlings and plants were studied during the summer. To prevent initial plant mortality, plots were kept relatively weed free for up to 40 days after emergence. The field was visited twice a week and at each time seedling establishment, time to emergence, leaf appearance, flowering stage, fruit set and time to maturing was recorded. Fruit number/vine was recorded in August and 10 mature fruits of plants at each replication were collected randomly to evaluate seed number/fruit. Data was analysed by SAS 9.1 to assess the effect of planting date on seed reproduction.

Daily thermal time (DTT) was used to calculate required degree-days following equation 1 to complete each stage of plant growth.

$$DTT = (T_o - T_b).F(T) \qquad \text{(equation 1)}$$

where F (T) is the temperature function, T_o is the optimum temperature and T_b is the base temperature. The first component of the daily thermal time $[(T_o - T_b)]$ is constant and non-optimal temperature will affect daily thermal time through F (T). F (T) is temperature function (reduction factor) that varies between 0 (at base and ceiling temperature) and 1 (at optimal temperature) (KAMKAR *et al.,* 2012). The base, optimum and ceiling temperature for *C. melo* are 20, 35 and 45 °C, respectively (SOHRABI *et al.,* 2012). Required degree day for occurrence of each phenological stage of wild melon were calculated by Model Maker software ver. 3.0 and using the weather data.

Results and Discussion

The calculated thermal time for each growth stage is presented in Table 1. Each growth stage achieved when F(T) = 1 and depend on planting date, required daily thermal time was different for each phonological stage. To complete growth cycle (emergence to maturing) of wild melons that were planted in late of May and 8 of June needed about 448 and 733 degree-days. Required DTT for emergence, 2 - 3 leaf stage, 5 - 6 leaf stage, branching stage, flowering, fruiting and maturing stage was 55, 93, 130, 169, 243, 317 and 448 degree-day, respectively for planting date of late of May and required DTT for occurrence the mentioned stages for planting date of 8 of June was about 54, 94, 131, 173, 183, 338 and 733 degree-day, respectively (Tab. 1). Earlier phenological stages had a high development rate (Fig. 1). Seeds of wild melon germinated as soon as soil temperature achieved to optimum temperature. The weed exhibited monoecious tendencies, with production of male flowers rapidly followed by production of both male and female flowers on the same vine. *C. melo* exhibited prolific fruit production, until senescence occurred at 75 and 92 days after establishment. The time of 50% fruit formation were observed between 49 and 54 days after emergence, depending on temperature condition and date of planting (Tab. 1).

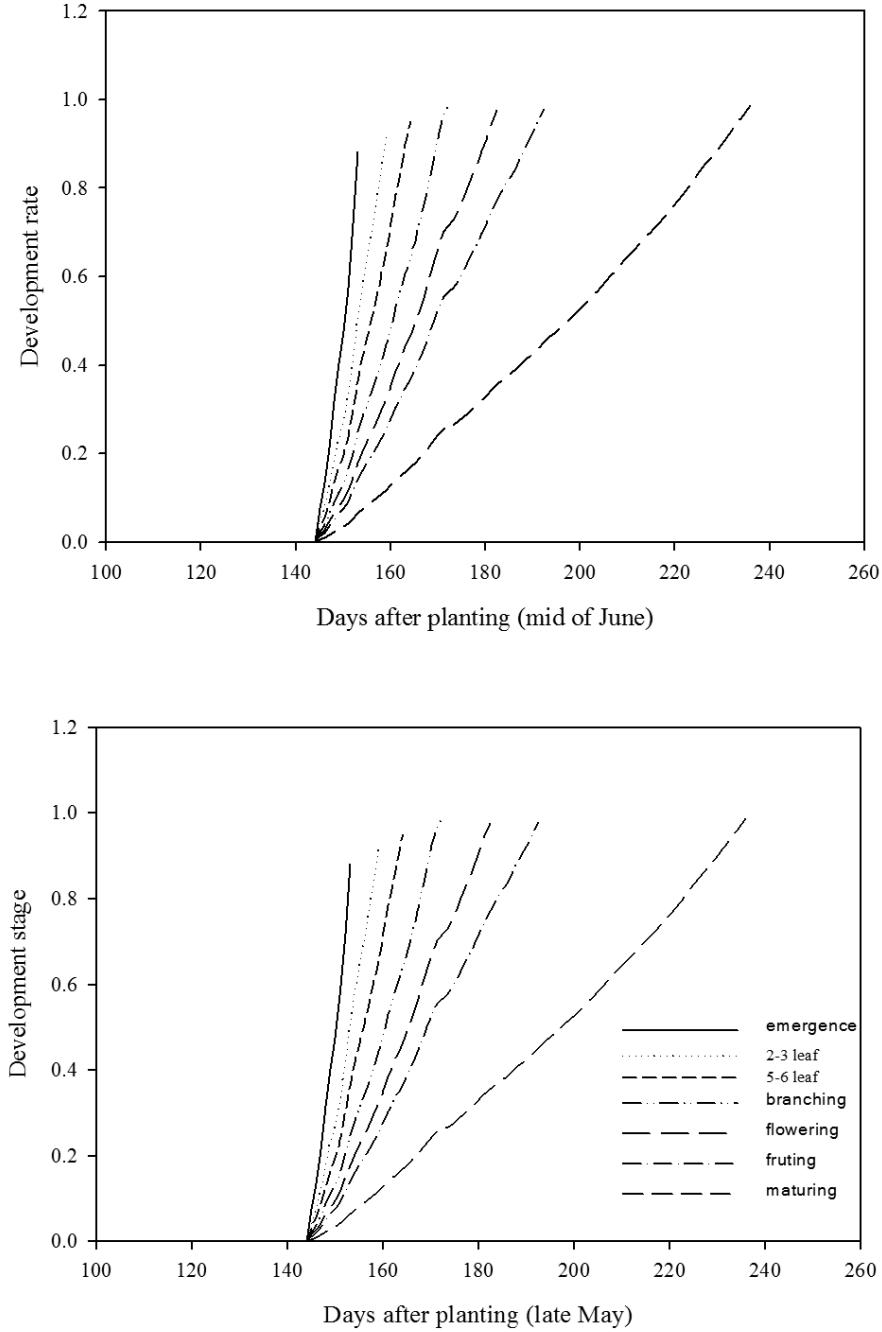

Fig. 1 Development rate (phenological stages) of wild melon (A and B).

Abb. 1 *Entwicklungsstufen (phänologische Stadien) der Wildmelone (A und B).*

Tab. 1 Phenology and growth parameters assessed for wild melon at summer 2012.

***Tab. 1** Phänologie und Wachstumsparameter für Wildmelonen (Erfassung im Sommer 2012).*

Phenological stage (Time to 50%)	**DTT, days after planting (in late of May)**	**DTT, days after planting (in 8 of Jun)**
Emergence	55, 15	54, 10
2-3 leaf	93, 22	94, 16
5-6 leaf	130, 28	131, 21
Branching	169, 34	173, 29
Flowering	243, 43	183, 39
Fruiting	317, 54	338, 49
Maturing	448, 75	733, 92
Fruits per plant	45.3	34.3
Seeds per fruit	189.9	172.13
Dry weight g per 100 seed	0.55	0.62

DDT: daily themal time

During the 75 and 92 days of wild melon growth, the mean number of fruits per plant and seeds per fruit were about 45 and 190, respectively for late of May planting date and about 34.33 and 172.13, respectively for the other planting date (8 of June). Seed number per vine was up to 5000 for both planting dates and the mean seed weight were about 0.55 and 0.62 g/100 seeds in May and June planting date, respectively (Tab. 1).

The first fruit formation was observed in prickly paddy melons (*Cucumis myriocarpus*) and camel melons (*Citrullus lanatus*) between 35 and 49 days after emergence. The camel melons and prickly melons produced a maximum of 14 and 120 fruits/plant, and 400 and 45 seeds/fruit, respectively (SHAIK *et al.*, 2011). Understanding phenological stages and their characteristics is crucial for design of durable weed management practices (DINCER *et al.*, 2010).

According to the results, wild melon could produce a lot of fruits and seeds within a growth period of 75 and 92 days. Knowing the time of phenological stages of wild melon and seed production characters helps producers and researchers to apply management practices in right time.

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