Morning glory (*Ipomoea grandifolia*) management with winter cover crops

Mateus Joaquim Duminelli Furquim[1], Henrique von Hertwig Bittencourt[2], Leonardo Khaoê Giovanetti[3], Lisandro Tomas da Silva Bonome[2] and Michelangelo Muzell Trezzi[4]

Abstract – Morning glory (*Ipomoea grandifolia*) is a resilient species that presents challenges for effective control, particularly due to herbicide-resistant biotypes. Our study evaluates the impact of winter cover crops shoot dry mass on morning glory establishment and development. The experiment was carried out in controlled conditions, utilizing shoots from black oat (BO), ryegrass (RG), vetch (VE), oilseed radish (OR), BO+VE, BO+OR, RG+VE, RG+OR, VE+OR, and a control group with uncovered soil. Cover crops reduced morning glory emergence up to 65%. Root length was suppressed up to 70%, while stem length and dry mass decreased by up to 20% and 76%, respectively, compared to the control group. Oilseed radish demonstrated the highest potential in suppressing morning glory.

Index terms: Cultural management; Integrated management; *Raphanus sativus;* weed.

Controle de corda-de-viola (*Ipomoea grandifolia*) com plantas de cobertura de inverno

Resumo – A corda-de-viola (*Ipomoea grandifolia*) é uma espécie que tem apresentado desafios para seu manejo, particularmente devido à existência de biótipos resistentes a herbicidas. Nosso estudo avaliou a influência da massa seca de plantas de cobertura de inverno e suas combinações no estabelecimento e na capacidade de desenvolvimento inicial de corda-de-viola. O experimento foi conduzido em condições controladas, utilizando resíduos das plantas de cobertura: aveia-preta (AV), azevém (AZ), ervilhaca (E), nabo-forrageiro (NF), AV+E, AV+NF, AZ+E, AZ+NF, E+NF e um controle sem plantas de cobertura. As plantas de cobertura impactaram a emergência de corda-de-viola, com redução de até 65%. O comprimento de raiz foi suprimido até 70%, enquanto a altura de planta e a massa seca diminuíram em 20% e 76%, respectivamente, em comparação com o controle. Nabo forrageiro apresentou o maior potencial de supressão de corda-de-viola.

Termos de indexação: Manejo cultural; Manejo integrado; Planta daninha; *Raphanus sativus*.

Among the various challenges of agricultural production, weeds represent a significant problem due to high management costs, weed control difficulty, and crop damage. In conventional agriculture, the control of these species is highly dependent on herbicides, representing approximately 61% of chemical products sold for use in Brazilian agriculture in 2022 (BRASIL, 2024). The inappropriate use of herbicides causes several environmental and human health problems, leading to the development of herbicide-resistant weed biotypes. Several weed species have herbicide-resistant biotypes in Brazil, and morning glory (*Ipomoea grandifolia*) is one of them (Pazuch *et al*., 2017).

The use of cover crops is an effective practice for managing weed populations in agricultural areas by using different mechanisms, such as the physical effect of straw deposition and the chemical impact of the production and release of allelochemicals (Reginatto *et al.,* 2020). However, information is needed on the effect of using different species of winter cover crops on the establishment and initial development of morning glory. We sought to evaluate the effect of dry masses of black oat (*Avena strigosa*), ryegrass (*Lolium multiflorum*), vetch (*Vicia sativa*), and oilseed radish (*Raphanus sativus*), single and intercropped, on morning glory emergence and initial development.

The experiment was conducted in 2022 at the Federal University of Fronteira Sul, Laranjeiras do Sul, Paraná, Brazil. In March, in an experimental area, black oat (BO), ryegrass (RG), vetch (VE), and oilseed radish (OR) were sown in densities of 70; 30; 65 and 15kg ha^{-1}, respectively, in soil with prior incorporation of tanned cattle manure (30Mg ha^{-1}). The cover crops were cut close to the ground 60 days after sowing, and its dry mass was determined (6.4; 2.6; 3.9, and 9.8 Mg ha^{-1} for BO, RG, VE, and OR, respectively). Subsequently, in a greenhouse (25±3°C) with sprinkler irrigation (12mm day^{-1}), the dry shots from the cover crops were placed on the soil surface of 8-liter pots (24 and 23cm wide and depth, respectively) in the proportions of 100% BO, 100% RG,

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[1] Agronomist, e-mail: mateus-duminelli@outlook.com
[2] Agronomist, Dr., Federal University of Fronteira Sul, e-mail: henrique.bittencourt@uffs.edu.br, lisandro.bonome@uffs.edu.br
[3] Agronomist, Me., Federal University of Santa Catarina, e-mail: leonardokgiovanetti@gmail.com
[4] Agronomist, Dr., Federal Technological University of Paraná, e-mail: trezzi@utfpr.edu.br

100% VE, 100% OR, 50% BO + 50% VE, 50% BO + 50% OR, 50% RG + 50% VE, 50% RG + 50% OR, 50% VE + 50% OR and 0% cover crops (control group), which consisted of the treatments, with four replications in a completely randomized design. Five morning glory seeds were sown per pot, after immersion in water initially heated at 95°C for 24h for seed dormancy breaking.

The percentage of morning glory emergence was determined by counting normal plants. On the 30th day after seeding, the plants were carefully extracted from the pots for measurements of their stem and primary root length using a caliper. The dry mass of each plant was then measured using a scale after drying in an oven at 70°C until constant weight. Data were subjected to the Shapiro-Wilk test for normality before analysis of variance (ANOVA) ($p<0.05$). The means were compared using Duncan's test ($p<0.05$) in the computational application R 4.2.0.

Treatments with oilseed radish (OR) reduced morning glory emergence by up to 65%, whereas other treatments showed no difference compared to the control group (Figure 1). This finding aligns with previous observations by Guerra *et al*. (2015), who also noted the suppressive effect of Brassicaceae on morning glory emergence, highlighting its potential for weed cultural management.

Plants from the Brassicaceae family, particularly OR, produce glucosinolates that enzymatically transform into isothiocyanates (ITC) (Jabran, 2017). These compounds have been demonstrated to inhibit the germination of weeds such as lambsquarters (*Chenopodium album*) and common chickweed (*Stellaria media*) (Kunz *et al.,* 2016). The hypothesis of an allelopathic involvement of OR on morning glory can be verified by research in the future.

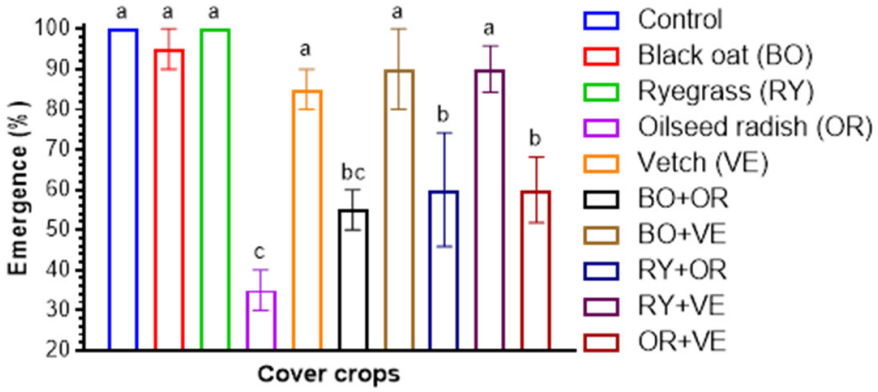

Figure 1. Emergence of morning glory (*I. grandifolia*) under different soil covers in controlled conditions in Laranjeiras do Sul, PR, Brazil

Figura 1. Emergência da corda de viola (I. grandifolia) com diferentes coberturas do solo em condições controladas em Laranjeiras do Sul, PR, Brasil

The soil cover with OR and RY+VE reduced the stem length of morning glory by 26 and 28% in comparison to BO, respectively, while the remaining treatments did not differ from each other (Figure 2a). The decrease in morning glory stem length may also be linked to natural products produced by these plants, such as glucosinolates, gallic acid, and cyanamide, produced by OR (KUNZ *et al*., 2016), RY (Vitalini *et al*., 2020), and VE (Sun *et al.,* 2022), respectively.

The primary root length of morning glory was reduced up to 70% with RY+OR in comparison to the control group, and only BO and RY did not differ from the latter (Figure 2b). The influence of OR may also be linked to the production of glucosinolates, because the higher sensitivity of the root system compared to the aerial parts of plants is documented in the literature (YI *et al.,* 2016). This is likely due to the radicle being the first plant organ to encounter chemical compounds in the environment during germination.

The morning glory dry mass was reduced up to 79% with OR compared to the control group. Alone or intercropped with black oat (BO+OR), with ryegrass

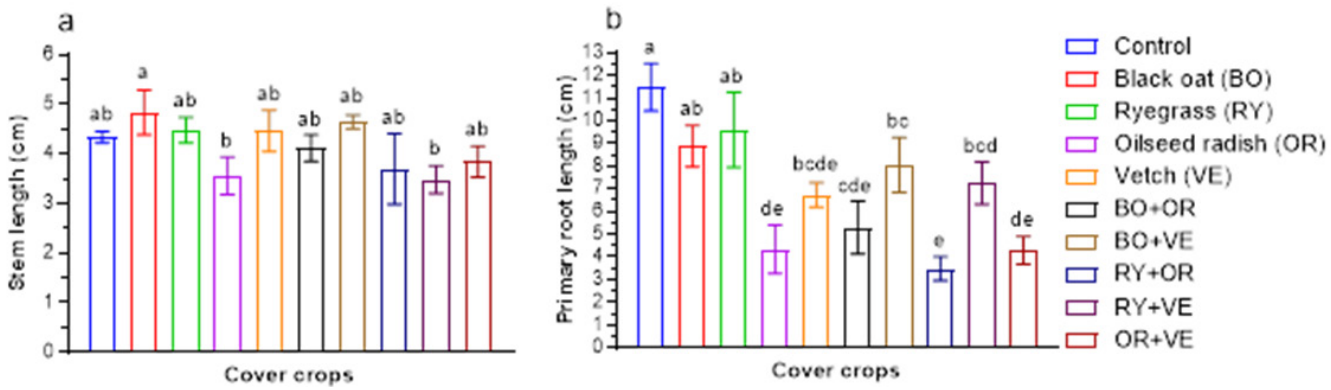

Figure 2. Stem (a) and primary root length (b) of morning glory (*I. grandifolia*) under different soil covers in controlled conditions in Laranjeiras do Sul, PR, Brazil

Figura 2. Parte aérea e tamanho da raiz primaria de corda de viola (I. grandifolia) com diferentes coberturas do solo em condições controladas em Laranjeiras do Sul, PR, Brasil

(RY+OR), or with vetch (OR+VE), oilseed radish pushed for the lowest morning glory dry mass (Figure 3).

Among the single cover crops tested, only OR reduced the dry mass of morning glory compared to the control group. This reduction in dry mass appears to be linked to inhibited root and shoot development, with the variables behaving similarly in relation to OR. Overall, single and intercropped OR reduced the establishment and initial development of morning glory, indicating its potential as an effective species for managing weeds, which should be confirmed by field experiments. To further elucidate the ecological dynamics between oilseed radish and morning glory, future studies should focus on identifying and quantifying the natural products responsible for their biological activity in plants.

In conclusion, soil cover with oilseed radish dry mass, alone or in combination with other cover crop species, decreased the emergence and initial development of the stem and primary root length of morning glory and its dry mass production.

Credit

Mateus Joaquim Duminelli Furquim, Henrique von Hertwig Bittencourt: conceptualization and methodology; Mateus Joaquim Duminelli Furquim, Henrique von Hertwig Bittencourt, Leonardo Khaoê Giovanetti, Lisandro Tomas da Silva Bonome: formal analysis and investigation; Mateus Joaquim Duminelli Furquim, Henrique von Hertwig Bittencourt, Leonardo Khaoê Giovanetti, Lisandro Tomas da Silva Bonome and Michelangelo Muzell Trezzi: writing and revision.

Research data

The authors will make the research data available upon request.

Conflict of interest

The authors declare no conflicts of interest in the development of this study.

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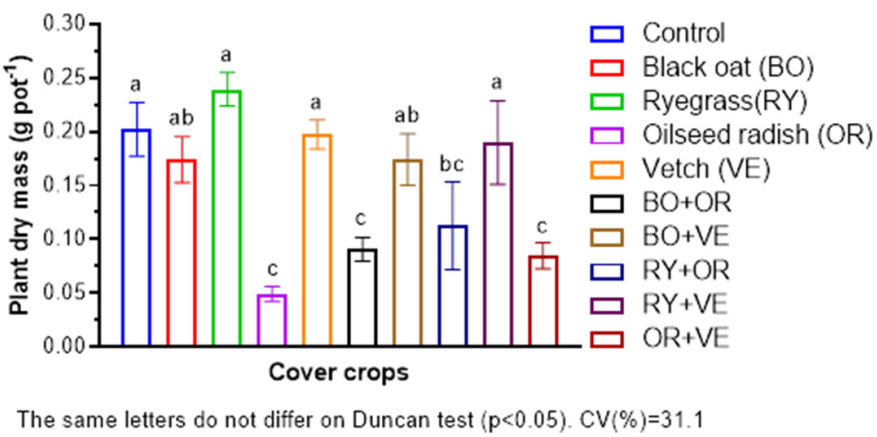

Figure 3. Dry mass of morning glory (*I. grandifolia*) under different soil covers in controlled conditions in Laranjeiras do Sul, PR, Brazil

Figura 3. Massa seca da corda de viola (I. grandifolia) com diferentes coberturas do solo em condições controladas em Laranjeiras do Sul, PR, Brasil