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Seed germination of *Cyperus obtusatus* (J. Presl & C. Presl) Mattf. & Kuk (Cyperaceae)

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Abstract

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Research on seed germination and dormancy allows us to explain the life strategy of a species, its distribution and dissemination in different environments. The present work was carried out with the objective of evaluating the germination of *Cyperus obtusatus* seeds, aiming at a better understanding of the plant development conditions. For this, the seeds were submitted to imbibition in distilled water in the following periods: 0, 4, 8, 12, 16, 20 hours. They were sown in Gerbox's, on substrate (germitest paper) moistened with distilled water and placed in Biochemical Oxygen Demand (B.O.D), under constant 30ºC and 16 hours of light. Seed germination was evaluated by means of the first germination count (PCG), germination speed index (IVG), germination (GER), dry mass (DM) and seedling length (COMP). The maximum or minimum point for quadratic equations was calculated from the derivative. *C. obtusatus* seeds did not show dormancy under the conditions of temperature, light and humidity provided in this experiment. The results treatment of 16 hours of imbibition indicate greater vigor of the seeds through the dry mass MS, IVG and PCG.

Keywords: seed physiology; weed; physiological potential

Introduction

Cyperaceae, inserted in Poales, is represented by about 5687 species distributed among 95 genera (Larridon et al., 2021). It is considered the third most representative family among the monocotyledons (Muasya et al., 2009; Rocha & Martins, 2011) and its representatives are characterized by being cosmopolitan with herbaceous habits, occurring in flooded areas, or even in predominantly dry areas. According to Schneider et al. (2020), Brazil has 647 species of this family grouped into 30 genera.

Cyperus obtusatus is distributed throughout Central America, in tropical and temperate regions of South America (Adams, 1994; Luceño et al., 1997). It is a terrestrial, native, non-endemic herb that occurs in twenty-five states in Brazil (Matzenauer et al. (2020). It is a perennial, cespitose plant with thick rhizomes, triangular scape with basal leaves reduced to sheaths, the others (Trevisan et al., 2007) the fruit of *C. obtusatus* is about 1-1.5 mm long by 0.5-1 mm wide, ellipsoid or obovoid to oblong, estramineous, blackish in shape. This species is found in restinga and riparian forest areas in the Atlantic Forest domain and in the ecotone region between the Atlantic Forest and Caatinga domains in Sergipe (Costa et al., 2012). In Rio Grande do Sul it is preferably distributed in the coastal region associated with humid sandy fields, dunes and grasslands. In sandy soils, unlike soils with a higher concentration of organic matter, the rhizome is thicker (Trevisan et al., 2007). In Alagoas, it is distributed in floodplain, restinga and Atlantic forest areas, usually in well-drained soils (SpeciesLink, 2022).

Although the diversity of Cyperaceae is greater in the tropics, its most diverse genus (*Carex* > 2000 spp.) occurs more frequently in temperate regions, where it presents high species diversity (Govaerts et al., 2022). *Cyperus* is the second largest genus with 950 species, the richest in tropical regions (Alves, 2015) and the one with the highest number of invasive plants (Moreira & Bragança, 2011). Some species such as *Cyperus esculentu*s, *Cyperus iria* and *Cyperus rotundus* are known as plants that cause agricultural damage, considered weeds of difficult control (Moreira & Bragança, 2011).

However, Simpson and Inglis (2001) demonstrated in their research the ethnobotanical value of the family, as the extraction of the fiber from the stem of *Cyperus esculentus* which is used to produce ropes in Libya, the stems and leaves can also be used for the manufacture of paper. The medicinal potential of *Cyperus* has been evidenced over the years, as in *Cyperus rotundus* (Sivapalan et al., 2013), as well as the antimicrobial potential Assunção et al. (2020).

According to Egorova (1999) in Cyperaceae the fruit is of the achene type, monospermic, indehiscent, with hard pericarp. There are two or three stigmas of different sizes in different species. The length of the embryo is the size of the seed and the endosperm is quite abundant. Cyperaceae seeds are relatively small, seeds weigh from just 0.0012 mg in Fimbristylis miliacea (Gordon, 1998) to about 60 mg in *Gahnia aspera* (W. Schutz, unpublished data). Very small seeds are typical of the genera *Cyperus, Fimbristylis, Scirpus* and *Eleochari*s (unpublished data W. Schütz) quoted in the work of Leck & Schütz (2005).

We know that the germination process can be affected by a series of intrinsic and extrinsic conditions, including humidity, temperature, substrate, light and oxygen. The set is essential for the process to occur normally (Carvalho, 2012). For Baskin & Baskin (1998) the nature of the seed coat, dormancy and seed size are known to markedly influence germination. Schutz (2000) observed that little is known about the germination conditions of species that occur in the humid and nutrient-poor habitats of tropical and subtropical regions.

In Cyperaceae generally under field conditions, light and temperature germination requirements for most species are met at or near the soil surface. The answers, however, vary between species and with habitat (Leck & Schütz, 2005).

Knowledge of *C. obtusatus* seed germination can increase the effectiveness of control methods as a weed or increase production as a plant of medicinal agricultural interest, aiming, through a better understanding of the moment of emergence, to reduce losses and increase income gains.

This work was carried out with the objective of evaluating the germination of *Cyperus obtusatus* seeds, aiming at a better understanding of the plant's development conditions.

Material and Methods

Collection of botanical material

Individuals of *Cyperus obtusatus* were collected in the Didactic Garden of the Laboratory of Vegetal Systematics (LSV), of the Campus of Engineering and Agricultural Sciences (CECA) of the Federal University of Alagoas (UFAL), Rio Largo-AL, identified by a specialist and deposited in the Herbarium from the Instituto do Meio Ambiente de Alagoas – (MAC) under voucher No. 65125. In December 2021, 21 inflorescences were collected from which the achenes were removed with sterilized tweezers and destined for drying in the open air, on two layers of paper towel, in light and room temperature for 7 days. Then they were stored in an impermeable glass container for 65 days. In this work the term achene was replaced by the term seed. The seeds were selected by the darkest color (dark brown). Clear, green seeds or those without an embryo were discarded. Finally, 600 seeds were selected for this study.

Procedures adopted for the Germination Test

Sowing: The seeds were soaked in plastic containers (200 ml), immersed in 50 ml of distilled water, at 0h, 4h, 8h, 12h, 16h and 20 hours of imbibition. Four replicates of 25 seeds were used for each treatment. Then, they were sown in transparent plastic Gerboxes, distributed equidistantly, on substrate (Germitest paper), moistened with distilled water in a proportion of 2.5 times the mass of the paper, then placed in (B.O.D) Biochemical Oxygen Demand, under a constant 30ºC and a photoperiod of 16 hours of light (Brasil, 2009).

First germination count (PCG): The first germination count was performed together with the germination test. Normal seedling counts started on the 7th day after sowing (DAS), extending to the 23rd day after sowing (DAS). The results were obtained by the arithmetic mean of the four samples and expressed in percentage.

Percentage (GER) and germination speed index (IVG): The count of the number of germinated seeds, in all treatments, was carried out on the 3rd and 7th day after sowing (DAS), then the counts began to be performed every other day until the 23rd (DAS). Seeds that originated normal seedlings with all essential structures were considered germinated. Therefore, at the end of each test, the percentage and speed of germination were calculated according to Labouriau & Valadares (1976) and Maguire (1962), respectively.

Percentage (GER): G(%) = N/A x 100, where N = Number of germinated seeds and A = total number of seeds placed to germinate. Germination Speed Index (IVG): IVG = G1/N1 + G2/N2 + Gn/Nn, where IVG = germination speed index, G1, G2 and Gn = number of germinated seeds computed in the first, second and last count and N1, N2 and Nn = number of days from sowing to the first, second and last count.

Seedling Length (COMP) and Dry Mass (MS): At the end of the germination test, the normal seedlings of each repetition were measured from the underground part (SP) to the aerial part (PA) with the aid of a graduated ruler and the results expressed in cm per seedling. After the measurement, the seedlings of each replication were placed in a forced ventilation oven at 80°C, in Kraft paper bags, for a period of 24 hours. After this time, the samples were placed in a desiccator with activated silica gel and weighed on an analytical balance with a precision of 0.0001 g, the result being expressed in grams/seedlings (Nakagawa, 1999).

The experiments were evaluated using a completely randomized design (DIC). Statistical analyzes were performed using SISVAR version 5.6 (Ferreira, 2011). The data obtained were subjected to analysis of variance and polynomial regression, using equations whose determination coefficients (R^2) were higher.

Results and Discussion

Based on the summary of the analysis of variance (Table 1), it can be seen that for all analyzed variables there were significant differences between treatments.

The quadratic regression model was significant for all analyzed variables and all equations were derived in an attempt to find maximum and minimum points.

The first germinated seeds were observed between 4 and 7 days after sowing (DAS) and germination lasted up to 23 days (Table 2). The slowest and most prolonged germination dynamics occurred in treatment 0 with 23 DAS. The first germinated seeds of *Cyperus obtusatus* are considered faster when compared to *C. rotundus* (11-34 DAS) and *C. esculentus* (10-11 DAS) under similar conditions (Donato et al., 2019; Priyanka et al., 2017).

Table 2. Germination percentage as a function of soaking period

Treatment	Germination, %	Days After Sowing (DAS)
0	65	23
4	64	21
8	69	21
12	73	21
16	75	21
20	73	14

According to Leck & Schütz (2005), small seed size is often associated with persistence in seed banks. For Donato et al. (2019) species that have seeds with a high level of dormancy, such as *C. rotundus*, more easily establish a persistent seed bank in the soil. For *C. obtusatus*, there was no significant primary dormancy, with the minimum percentage of germination greater than 50% (Table 1), indicating low persistence in the soil seed bank. Treatments of 8, 12, 16 and 20 hours obtained similar results in percentage of germination (GER) with minimum-maximum of 69 and 75% for treatments of 8 and 16 hours respectively.

The present study reveals that *C. obtusatus* develops at a constant temperature, and these data are similar to those found by Chozin and Nakagawa (1988) for *Cyperus iria*, which obtained 69% of germination at a constant temperature of 35°C and differs from the results of Donato et al. (2019) for *Cyperus rotundus* that at a constant temperature of 30°C, obtained only 1% of germination.

The seedling length (COMP) of *C. obtusatus* increased up to the 16-hour treatment, showing a gain of 0.8 cm/seedling (33.75%) more than the 0-hour treatment (Figure 1). After 16 hours there is a decrease, this can be explained with the help of Peske (2011), where he reports that the damage related to soaking can be attributed to the rupture of the cell membranes of the seeds, caused by the intense entry of water in the first moments of imbibition, due to the difference in water potential between the seed and the substrate where it is located. Bin et al. (2015) expose a similar situation.

Table 1. Summary of variance analysis of the variables first germination count, germination, germination speed index, dry mass and length of seedlings of *C. obtusatus* visited by imbibition

FV	Mean squares				
	PCG	GER	GVI	DM	COMP
Doses	10.183**	9.158**	10.008**	9.112**	9.224**
Residue	3.214	3.130	4.015	3.116	5.447
CV, %	10.28	11.50	10.58	11.01	14.25

** significant at 1% probability.

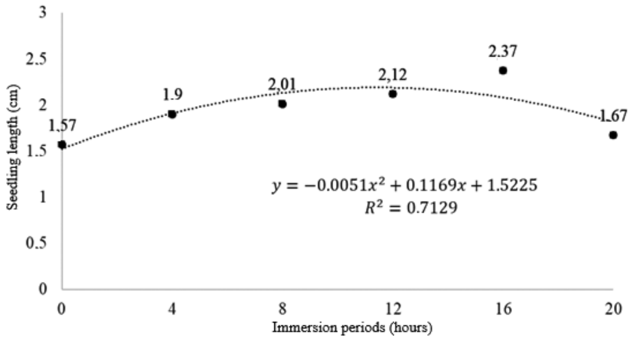

Fig. 1. Seedling length (COMP) of *C. obtusatus* as a function of imbibition

The dry mass (DM) showed a behavior similar to the length, increase up to the 16-hour treatment, with 0.0030 g/seedling (63.8%) more than the 0-hour treatment (Figure 2). Nakagawa (1999) can explain this when he states that under conditions favorable to germination, seeds originate seedlings with a higher growth rate, due to the greater capacity for transformation and supply of storage tissue reserves and greater incorporation of these by the embryonic axis. Oliveira et al. (2014) report that evaluations of shoot and root dry mass are of great importance in the evaluation of plant development, ensuring the establishment of seedlings in the field. It should be noted that the incidence of abnormal seedlings was not significantly affected by increased exposure of seeds to imbibition periods, a fact proven from 4 pm onwards. Monteiro et al. (2014) working with soybean cultivars noted that all evaluated species decreased linearly with increasing submersion period.

The first germination count (PCG) indicates that the 12-20 hour imbibition showed more germinated seeds on the 7th day, with the 16-hour treatment generating more normal seedlings, represented by 22% more germination than treatment 0 (Figure 3). The first count test is important, as it evaluates the germination speed, indicating that the greater the seed germination in the first count, the greater its vigor will be (Nakagawa, 1999). There is great competition between seedlings in clearing habitats, as individuals that emerge earlier may have a certain competitive advantage over those that emerge later, typical characteristics of pioneer species (Garwood, 1983).

Regarding seed vigor, indirectly measured by the Germination Speed Index (GVI), it was noted that the best results were obtained for treatments with longer imbibition period, mainly those of 16-20 hours (Figure 4). According to Nakagawa (1999), the higher the IVG, the higher the germination speed, which allows inferring that the seed is more vigorous. Rahman et al. (2011) reported that hydration temperature could markedly alter seed viability and vigor. In this way, water plays a key role in the development process, as the seed changes from a metabolically active state to an in-

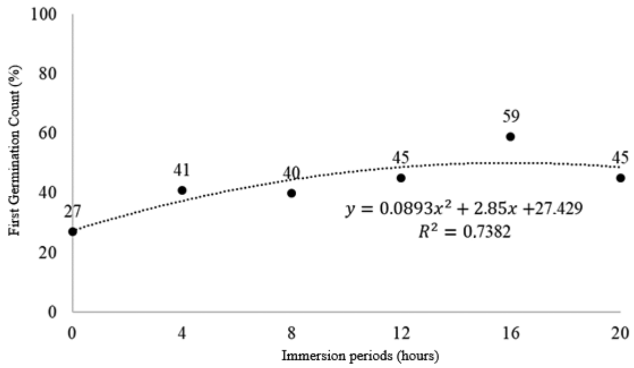

Fig. 3. First germination count (PCG) of *C. obtusatus* as a function of imbibition

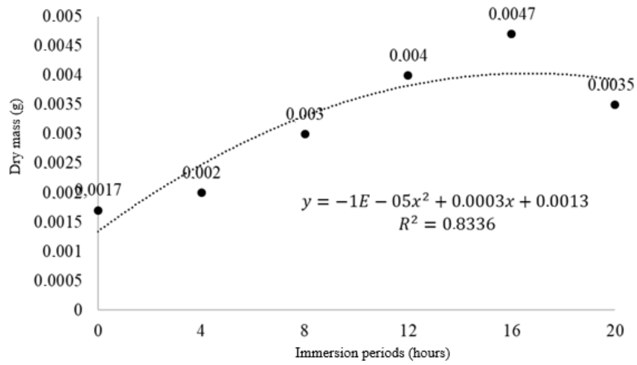

Fig. 2. Dry mass (DM) of *C. obtusatus* seedlings as a function of imbibition

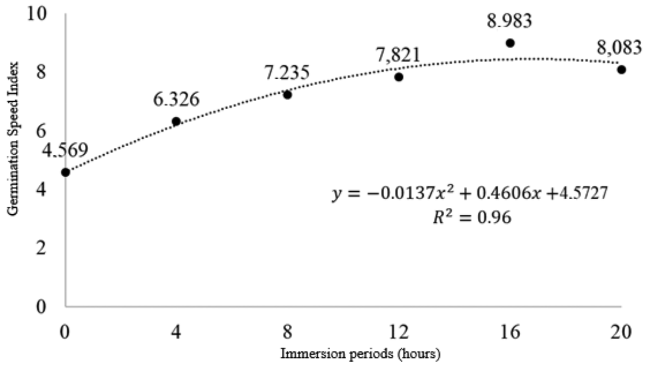

Fig. 4. Germination Speed Index (GVI) of *C. obtusatus* submitted to imbibition

active one after maturation, due to desiccation, returning to the metabolically active state during germination (Ferreira & Borghetti, 2004).

Conclusions

The constant temperature of 30ºC stimulated the germination of *C. obtusatus,* there was no significant primary dormancy. The optimum point for imbibition occurred at 16 hours.

References

Adams, C. D. (1994). Kyllinga Rottb. (Cyperaceae). *In:* Davidse, G.; Sousa, M.S.; Chater, A.O. (eds.). Flora Mesoamericana – Alismataceae a Cyperaceae. Universidad Nacional Autónoma de México. Missouri Botanical Garden, The Natural History Museum (London). *6,* 402-501.

Alves, M. (2015). Cyperaceae in the Species List of the Flora of Brazil. Rio de Janeiro Botanical Garden. Available at: <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB35092>

Assunção, A. C., Prata, A. P. N., Nascimento, T. G., Almeida, L. M., Silva, S. A. S., Nascimento, H. H. C., Freitas, J. M. D. & Santos, M. J. L. (2020). Technological prospecting of species from the Genus Cyperus L. (Cyperaceae): An investigation of their antimicrobial potential. *Revista Humanidades e Inovação, 7*(4), 316-326.

Baskin, C. C. & Baskin, J. M. (1998). Seed Ecology, Biogeography and Evolution of Dormancy and Germination. *Academic Press,* San Diego.

Bin, A., Brandão, C. A., Vigolo, M., Andrade, N. Z. & Derré, L. O. (2015). Evaluation of germination in soybean seeds subjected to different soaking periods. *Colloquium Agrariae, 11(Especial),* 08-13.

Brasil (2009). Ministry of Agriculture, Livestock, and Supply. Rules for Seed Analysis. 1st ed. Available at https://www.gov.br/agricultura/pt-br/assuntos/insumos-agropecuarios/arquivos-publicacoes-insumos/2946_regras_analise__sementes.pdf.

Carvalho, N. M. & Nakagawa, J. (2012). Seeds: Science, Technology and Production. 4th ed. *Jaboticabal: FUNEP,* 588.

Chozin, M. A. & Nakagawa, K. (1988). Autecological Studies on *Cyperus iria* L. and *C. microiria* STEUD., Annual Cyperaceous Weeds. *Weed Research, Japan, 33,* 23–30.

Costa, S. M., Prata, A. P. & Alves, M. (2012). *Kyllinga* (Cyperaceae) from the state of Sergipe, Brazil. *Rodriguésia*, *63*(4), 795-802.

Egorova, T. (1999). The sedges (*Carex* L.) of Russia and adjacent states (within the limits of former USSR). *Missouri Garden Press, St. Petersburg, St.- Louis,* 772.

Ferreira, A. G. & Borghetti, F. B. (2004). Germination: From Basics to Applied. Porto Alegre. Artmed, 323.

Ferreira, D. F. (2011). Sisvar: a computer statistical analysis system. *Science and Agrotechnology*, *35*(6), 1039-1042.

Garwood, N. C. (1983). Seed germination in a seasonal tropical forest in Panama: a community study. *Ecological Monographs, 53*, 159-181.

Gordon, E. (1998). Seed characteristics of plant species from riverine wetlands in Venezuela. *Aquat. Bot., 50,* 417-431.

Govaerts, R., Simpson, D. A., Bruhl, J., Egorova, T., Goetghebeur, P. & Wilson, K. (2022). World checklist of Cyperaceae. Kew: The Board of Trustees of the Royal Botanic Gardens, Kew. Available at: https://wcsp.science.kew.org/reportbuilder.do. Accessed on Nov 02, 2022.

Larridon, I. (2021). A molecular phylogenetic study of African members of tribe Hypolytreae (Mapanioideae, Cyperaceae). *Bot. J. Linn. Soc.*, https://doi.org/10.1093/botlinnean/boab088

Leck, M. A. & Schütz, W. (2005). Regeneration of Cyperaceae, with particular reference to seed ecology and seed banks. *Perspect. Plant Ecol. Evol. Syst., 7,* 95-133.

Lia (2021). Irrigation and Agrometeorology Laboratory; Automatic Agrometeorological Station, Campus of Engineering and Agricultural Sciences (CECA) at the Federal University of Alagoas (UFAL), Rio Largo-AL. Latitude: 9°28'29.1"S; Longitude: 35°49'43.6"W; Altitude: 127.0 m.

Luceño, M., Alves, M. V. & Mendes, A. P. (1997) Floristic catalog and identification keys of the Cyperaceae in the states of Paraíba and Pernambuco (Northeast Brazil). Anales del Jardín Botánico de Madrid, 57, 67-100.

Maguire, J. D. (1962). Speed of germination aid in selection and evaluation for seedling emergence and vigor. *Crop Science,* Madison, *2*(2), 76-77.

Matzenauer, W., Pereira-Silva, L. & Hefler, S. M. (2020) Cyperus in Flora do Brasil 2020. Rio de Janeiro Botanical Garden. Available at: http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB49788. Accessed on Feb 11, 2022.

Monteiro, M. A., Martins, A. B. N., Véra, J. G., de Medeiros, L. R. **& Costa, C. J. (**2014). Effects of different periods of water immersion on the germination of soybean seeds. 12th Postgraduate and Research Journey. Revista Congrega Ercamp, 1-12.

Moreira, H. J. Da C. & Bragança, H. B. N. (2011). Manual of weed plant identification. FMC Agricultural Products, Campinas, 1017.

Muasya, A. M., Simpson, D. A., Verboom, G. A., Goetghebeur, P., Naczi, R. F. C., Chase, M. W. & Smets, E. (2009). Phylogeny of Cyperaceae based on DNA sequence data: current progress and future prospects. *The Botanical Review, 75*(1)*,* 2-21. https://doi.org/10.1007/s12229-008-9019-3

Nakagawa, J. (1999). Seed vigor tests based on seedling performance. In: Krzyzanowski, F. C.; Vieira, R. D.; França Neto, J. B. Seed vigor: concepts and tests. Londrina: Informativo ABRATES, 2.1-2.24.

Oliveira, A. K. M., Ribeiro, J. W. F., Pereira, K. C. L. & Silva, C. A. A. (2014). Germination of Eriotheca gracilipes (K. Schum.) A. Robyns seeds at different temperatures. *Científica*, *42*(4), 316–324.

Peske, S. T. & Peske, F. B. (2011). Water absorption under stress. *Seed News,* (3), 1-5.

Priyanka, D., Debasmita, G. D., Rawat, A. K. S. (2017). Medicinal chemistry and biological potential of *Cyperus rotundus* Linn.: An overview to discover elite chemotype(s) for industrial use. *Industrial Crops and Products*, (108), 232.

Rahman, M. M., Ahammad, K. U. & Alam, M. M. (2011). Effect of soaking condition and temperature on imbibition rate of maize and chickpea seeds. *Research Journal of Seed Science, 4*(2),117-124.

Rocha, D. C. & Martins, D. (2011). Morphoanatomical adaptations of Cyperaceae to the aquatic environment. *Planta Daninha, 29*(1), 7-15. https://doi.org/10.1590/S0100-83582011000100002

Schutz, W. (2000). Ecology of dormancy and seed germination in sedges (*Carex*). *Perspective. Eco plant. Evolve.*

Simpson, D. A. & Inglis, C. A. (2001). Cyperaceae of Economic and Horticultural Importance: a Checklist. *Kew Bulletin, 56*(2), 257–360.

Sivapalan, S. R. (2013). Medicinal uses and pharmacological activities of *Cyperus rotundus* Linn-A Review. *International Journal of Scientific and Research Publications, 3*(5), 1-8.

SPECIESLINK (2022). SpeciesLink network, specieslink.net/search; filtros; (norm_country:Brasil) AND ((genus:*Kyllinga* AND species:*vaginata*)) AND (norm_stateprovince:Alagoas) disponível em < https://specieslink.net/search/ > Acessado em 04-Dez-2022 13:46:22.

Trevisan, R., Ludtke, R. & Boldrini (2007). The genus *Kyllinga* Rottb. (Cyperaceae) in Rio Grande do Sul v.5. n 2-3. Porto Alegre. *Brazilian Journal of Biosciences*, 27-36.

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