



RESEARCH ARTICLE

COMPARISON OF BITTER GOURD (*Momordica Charantia L.*) VARIETIES UNDER THE INFLUENCE OF SALT STRESS

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ABSTRACT

The experiment was performed during 2022 to compare Bitter gourd (*Momordica charantia L.*) varieties under the influence of salt stress. And three-replicated Completely Randomized Design (CRD) design was used for its layout (factorial). The bitter gourd that was grown in canal water (the control) ended up coming in first place. It had a germination rate of 73.68%, a germination index of 1.83%, a vine length of 14.64 cm, a leaves of 5.06 plant, a root length of 13.02 cm, a root biomass of 1.33 g. The bitter gourd was provided with 2 dSm¹ and it finished in second place. It had a germination rate of 63.64%, a germination index of 1.67, a vine length of 14.08 cm, a leaf yield of 4.94 leaves plant, a root length of 12.51 cm, a root biomass of 1.23 g. The bitter gourd came in third place after receiving 4 dSm¹ and achieving the following results: a germination rate of 39.33%, a germination index of 1.33, a vine length of 12.75 cm, a leaf yield of 4.84 leaves plant, a root length of 10.35 cm, and 1.11 g from its roots. This The plants that were given 6 dSm¹ had a germination rate of 37.23 %, a germination index of 1.21, a vine length of 8.63 cm 4.32 leaves per plant, a root length of 9.19 cm, 0.88 g of root biomass, from their leaves, which placed them in fourth place. In a manner analogous, the Bitter gourd 8 dSm¹ had a germination rate of 31.93%, a germination index of 0.92, a vine length of 6.15 cm, a leaf yield of 4.10 leaves plant, a root length of 8.06 cm, a root biomass of 0.57 g. . All of these measurements were taken in the Kiran variety performed the best out of those that were examined. It had a germination rate of 56.52 %, an index of 4.42, a vine length of 11.33 cm, a leaf yield of 4.67 per plant, a root length of 10.63 cm, a root biomass of 1.54 g. Additionally Peshawar, the variety that came in second place, had a germination rate of 41.8 %, a germination index of 4.02, a vine length of 11.17 cm, a leaf yield of 4.63 leaves per plant, a root length of 10.62 cm, a root biomass of 0.51 g. These are the statistics that were used to According to the findings of this experiment; bitter gourds that were subjected to treatment with canal water (the control) exhibited the greatest rates of the germination and vegetative growth and developments, followed by bitter gourds that were subjected to treatment with either 2 or 4 dSm¹.

KEYWORDS

Seed Germination, Vegetative Growth of Bitter Gourd, Salt Stress.

1. INTRODUCTION

Bittergourd. (*Momordica Charantia L.*) Is a climbing vine that produces pods that contain fruit that is both sweet and juicy. It belongs to the own circle of relatives Cucurbitaceae and is labeled as a member of the genus *Momordica* with inside the plant kingdom. It is feasible that the sour gourd changed into to begin with domesticated in southern China or jap India, even though it maximum probable befell in jap Asia (Miniraj et al., 2016). Bitter gourd is taken into consideration to be terrific meals due to the fact to the very excessive tiers of sickness-preventing and fitness-selling phytochemicals that it contains (Grover and Yadav, 2017). The maximum probable vicinity for the domestication of the sour gourd changed into in japance Asia, particularly in both jap India or southern China Because it consists of phytochemical ingredients, sour gourd is useful for your fitness as it facilitates save you sickness and promotes ordinary wellbeing The majority of human beings devour roasted sour gourd at the same time as it's miles both nevertheless inexperienced or simply beginning to show yellow in color.

Bitter gourd, a common: aspect with inside the delicacies of South Asia, is regularly followed with potatoes and yoghurt, which assist to masks the taste of the vegetable (Krawinkel and Keding, 2017). Bitter gourd tastes the greatest whilst it's miles nevertheless inexperienced or while it's miles simply beginning to show yellow; after it reaches this stage, it need to be fried earlier than being consumed. This dish is a conventional in South Asian delicacies and can be made much less sour through serving it with potatoes and a dollop of yoghurt at the side. Bitter gourd is a vegetable that may be determined in Southeast Asian delicacies. In Pakistan and Bangladesh, sour gourd is regularly organized in a dish that still onions, powdered purple chilli, powdered turmeric, powdered coriander and a sprinkling of cumin seeds (Begum et al., 2017). Bitter gourd that has been cooked is regularly served with onions, purple chilli powder, turmeric powder, salt, coriander powder, and a dusting of cumin seeds.

This dish is huge in each Pakistan and Bangladesh. Bitter gourd incorporates 93.ninety five mg of water, 19 calories, and 4.32 mg of carbohydrates. 1.ninety five mg of sugars, 2 mg of fibre, 0.18 mg of fat,

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0.8 mg of protein, 6 global devices of diet A, sixty eight global devices of beta- carotene, 1323 global devices of lutein zeaxanthin, 0.051 mg of thiamine, and (Chen et al., 2017). In dry and semiarid settings, salinity is one of the maximum great abiotic stressors that limits crop productivity. This is due to the fact soil salt awareness is regularly excessive in those situations, and precipitation is generally scarce. There is a opportunity that salt load inside the irrigation water, immoderate use of fertilizers, insufficient drainage, and water loss from the soil floor attributable to transpiration and evaporation are all elements in this (Atlassi et al., 2009). The salinity of the soil is the maximum vital component that has a unfavorable impact at the manufacturing of this vital crop. Other elements additionally have an unfavorable impact. In the world's driest climes, this type of aspect takes place on a reasonably ordinary basis.

Since pretty a few times, this hassle has been a great one for the land of Pakistan. Over 6.three million hectares of land are actually at hazard from salinity. Salts, including chlorides and sulphates of sodium, calcium, and magnesium, have a power on 2. three million acres of land in Sindh, even though this isn't always the case in Baluchistan (Qados and Amira, 2011). Salinity has a unfavorable impact on round 14% of Pakistan's irrigated land, which quantities to more or less 6.three million hectares. As a consequence, Pakistan's agricultural output has reduced through 64% (Afzal et al., 2005). Since sodium chloride is the maximum everyday type of salt that contributes to Stalinizations, its miles hypothesized that flowers have state-of-the-art regulatory mechanisms to save you the buildup of sodium chloride (Munns and Tester, 2008).

2. MATERIALS AND METHODS

The pot experiment was conducted during, 2022 to compare Bitter gourd (*Momordica charantia* L.) varieties under the influence of salt stress. For this study Completely Randomized Design (CRD) was laid out three replications. In each pot nine seeds were sown. The mixture of growing medium was fill in earthen pots, leaving approximately one inch space at the top. The experiment was conducted in Completely Randomized Design (CRD) with factorial arrangement. The experiment was laid out with three replications and each replication comprised of three pots.

Experimental factors: Two factors viz. Varieties and treatments was used to evaluate the efficacy of each factor independently as well as on interaction basis.

Factor-A: Varieties

The factor A was contain two varieties i.e. (i) Kiran (ii) Peshawar was investigate the effect of salt stress on the seed germination and seedling growth production.

Factor-B: Salt stress level

The factor B was contains salt stress level with given ratio. SSL1= canal water (control), SSL2=2 dSm¹, SSL3=4 dSm¹, SSL4=6 dSm¹, SSL5=8 dSm¹.

2.1 Statistical Design

The data were statistically analyses for analysis variance (ANOVA) using software statistics package 8.1 (Sutastix, 2006).

3. RESULTS

The experiment was conducted during 2020 to study the seed Germination and vegetative growth of Bitter gourd (*Momordica charantia* L.) under the influence of salt stress. The trial was laid out randomized complete block design with three replications (factorial). The treatments included canal water (control), SSL2=2 dSm¹, SSL3=4 dSm¹, SSL4=6 dSm¹, SSL5=8 dSm¹, against varieties V₁ = Kiran, V₂ Peshawar. The observations were recorded on germination (%), germination index, vine length (cm), number of leaves plant", root length (cm), root biomass (g). The data on the above parameters are presented in tables (1-2)

3.1 Germination (%)

The results on the average germination of bitter gourd cultivars as influenced by varied saline levels are shown in Table 1 it was shown that the degree of salt, the variety, and the interaction between the two had a statistically impact on germination (P<0.05). The canal water served as a control, where the germination rate of bitter gourd was 73.68 percent on average, followed by 63.64% and 39.33% at 2 dSm¹ and 4 dSm¹, respectively. The rate of germination of bitter gourd seeds was 37.23 percent when they were subjected to a dose of 6 dSm¹, while the rate was only 31.93 when they were treated to a dose of 8 dSm¹. In terms of the variations of bitter gourd, the Kiran variety had a germination rate of

56.52 percent, while the Peshawar variety had only a rate of 41.80 percent. The plants of the Kiran variety that were cultivated in canal water (the control) had the greatest germination percentage, which was 97.68%; the plants of the Kiran variety that were grown in 8 dSm¹ had the lowest germination percentage, which was 31.92%.

3.2 Germination Index

The results of the average germination index of bitter gourd kinds as influenced by various salt levels are shown in Table 1. According to the results of the analysis of variance, there was a statistically significant influence on the germination index brought about by (P < 0.05) differences in the amount of salt used, the varieties used, and the interaction between the two. The bitter gourd germination index was greatest in the canal water (control), which had a value of 1.83, followed by 2 dSm¹ (1.67) and then 4 dSm¹ (1.67). (1.33). On bitter gourd, a germination index of 8 dSm¹ produced the lowest possible value, while a germination index of 6 dSm¹ produced the highest possible value. In a comparison of the many types of bitter gourd, the Kiran variety has a germination index that is much greater than the Peshawar kind (4.42). (4.02). In the presence of 8 dSm¹, the Peshawar variety produced plants with a germination index of 489, whereas the interaction of canal water (the control) and the Peshawar variety produced plants with a germination index of 1.25.

3.3 Vine Length (cm)

The results of the average germination index of bitter gourd kinds as influenced by various salt levels are shown in Table 1. According to the results of the analysis of variance, there was a statistically significant influence on the germination index brought about by (P < 0.05) impact on vine length. On average, bitter gourd vines length of 14.64 cm were detected in canal water (the control), followed by those with a length of 14.08 cm from 2 dSm¹ and 12.75 cm from 4 For bitter gourd, the smallest vine length that could be reached with 8 dSm¹ was 615 cm, while the maximum vine length that could be produced with 6 dSm¹ was 8.63 Compared to the vines of the bitter gourd variety Peshawar, the vines of the bitter gourd variety Kiran were discernibly longer by 11.33 cm (11.17 cm). The plants that subjected to the combined effects of canal water (the control) and the variety Peshawar produced the longest vines (14.67 centimetres), while the plants that were subjected to the combined effects of 8 dSm¹ and the variety Peshawar produced the shortest vines (14.67 cm) (6.1cm).

3.4 Number of Leaves Plant¹

The data are shown in Table 1 indicate how different levels of saline effect the average number of leaves produced by a plant of a given cultivar of bitter gourd. An analysis of variance revealed that there was a statistically significant (05) relationship between the amount of salt present and the type of plant grown, as well as the interaction between the two. The canal water (control) sample had the greatest average number of leaves per plant for bitter gourd at 5.06, followed by the 2 dSm¹ and 4 samples with 4.94 and 4.86 leaves respectively (4.84 leaves). When bitter gourd was treated with 6 dSm¹ 6.32 leaves were produced per plant. However, when 8 dSm¹ was given, the bare minimum for leaf production was obtained at 4.10 leaves plant¹ The bitter gourd variety known as Kiran has almost four times as many leaves on each plant as the bitter gourd variety known as Peshawar, which has just two leaves per plant (4.63). The highest levels of plant productivity were discovered in the interaction between canal water (the control) and the Kiran treatment (5.09 leaves plant), while the lowest levels of plant productivity were identified in the Peshawar treatment 8 dSm¹ (4.08 leaves plant).

3.5 Root Length (cm)

The effects of varying salt concentrations on the typical root length of bitter gourd cultivars are shown in Table 2. An analysis of variance (ANOVA) was performed, and the results revealed at the degree of salt, variety, and combination of the two all had a statistically significant (P<0.05) affect on roots length. The group that was grown in canal water (the control) had the longest bitter gourd roots, measuring an average of 13.02 cm in length, followed by the groups that were grown in and 2 dSm¹ and 4 dSm¹ which measured 12.51 2 and 10.35 cm, respectively. The root lengths of the bitter gourd that was treated with 6 dSm¹ was on average 9.19 cm, while the root lengths of the bitter gourd that was treated with 8 dSm¹ was the shortest at 8.06 cm. When we compared several cultivars of bitter gourd, we discovered that Kiran had a root length that was 10.63 cm longer than Peshawar (10.62 cm). The interaction between canal water (the control) and the variety Peshawar produced the largest root length, which measured 13.1 cm, whereas the interaction between 8 dSm¹ and the variety Kiran produced the lowest root length, which measured 8.0 cm.

Table 1: Germination (%), Germination index, Vine length (cm) and Number of Leaves Plant⁻¹ of Bitter Gourd Varieties Under Different Salt Stress.

Treatments	Varities		Mean
	Kiran	Peshawar	
Germination %			
SSL1= canal water (control)	97.68	49.68	73.68 A
SSL2=2 dSm ⁻¹	77.64	49.65	63.64 B
SSL3=4 dSm ⁻¹	38.12	40.55	39.33 C
SSL4=6 dSm ⁻¹	37.28	37.18	37.23 CD
SSL5=8 dSm ⁻¹	31.92	31.95	31.93 D
Mean	56.52 A	41.80 B	
Germination Index			
SSL1= canal water (control)	1.17	1.25	1.83 A
SSL2=2 dSm ⁻¹	1.17	1.08	1.67 B
SSL3=4 dSm ⁻¹	1.00	0.83	1.33 C
SSL4=6 dSm ⁻¹	0.92	0.75	1.21 CD
SSL5=8 dSm ⁻¹	0.83	0.50	0.92 D
Mean	4.42 A	4.02 B	
Vine Length (cm)			
SSL1= canal water (control)	14.62	14.67	14.64 A
SSL2=2 dSm ⁻¹	14.17	13.99	14.08 B
SSL3=4 dSm ⁻¹	12.83	12.67	12.75 C
SSL4=6 dSm ⁻¹	8.83	8.43	8.63 D
SSL5=8 dSm ⁻¹	6.20	6.10	6.15 E
Mean	11.33 A	11.17 B	
Number of leaves plant ⁻¹			
SSL1= canal water (control)	5.09	5.03	5.06 A
SSL2=2 dSm ⁻¹	4.96	4.92	4.94 B
SSL3=4 dSm ⁻¹	4.83	4.86	4.84 C
SSL4=6 dSm ⁻¹	4.36	4.29	4.32 D
SSL5=8 dSm ⁻¹	4.13	4.08	4.10 E
Mean	4.67 A	4.63 B	

3.6 Root Biomass (g)

Table 2: Root Length (cm), and Root Biomass (g) Of Bitter Gourd Varieties Under Different Salt Stress.

Treatments	Varities		Mean
	Kiran	Peshawar	
Root length (cm)			
SSL1= canal water (control)	13.00	13.04	13.02 A
SSL2=2 dSm ¹	12.53	12.49	12.51 B
SSL3=4 dSm ¹	10.37	10.33	10.35 C
SSL4=6 dSm ¹	9.22	9.17	9.19 D
SSL5=8 dSm ¹	8.04	8.09	8.06 E
Mean	10.63 A	10.62 A	
Root biomass (g)			
SSL1= canal water (control)	0.73	0.67	1.33 A
SSL2=2 dSm ¹	0.67	0.62	1.23 B
SSL3=4 dSm ¹	0.58	0.56	1.11 C
SSL4=6 dSm ¹	0.45	0.44	0.88 D
SSL5=8 dSm ¹	0.30	0.28	0.57 E
Mean	1.54 A	0.51 B	

The effects of various salt concentrations on the root biomass of bitter gourd cultivars are broken down in detail in Table 2. It was shown that salt levels, cultivars, and the Interaction between the two all had a significant impact ($P < 0.05$) on the amount of biomass found in the roots. The canal water served as the control for this experiment, and it produced the greatest average root biomass for bitter gourd (1.33 g), followed by 2 dSm⁻¹ (1.23 g) and 4 dSm⁻¹ (1.11 g). The quantity of root biomass produced by the bitter gourd when it was treated with 6 dSm⁻¹ was 0.88 g, while the amount produced by 8 dSm⁻¹ was the least at 0.57 g. We observed that the root biomass of the Kiran variety of bitter gourd was significantly bigger than that of the Peshawar cultivar by a margin of 1.54 g when we compared the two types of bitter gourd varieties (0.51 g). The combination between 8 dSm⁻¹ and the Peshawar variety resulted in the lowest root biomass (0.28 g), whereas the interaction between canal water (the control) and the Peshawar variety produced the greatest root biomass (0.73 g).

4. DISCUSSION

The smooth and flavorful fruit pod of the mountain climbing vine called bitter gourd (*Momordica charantia* L.) is what makes this plant so famous amongst gardeners. It belongs to the own circle of relatives Cucurbitaceae and is labeled as a member of the genus *Momordica* within the plant kingdom. It is thought that the bitter gourd became to begin with domesticated in both Japanese India or southern China, each of that are positioned in Japanese Asia (Miniraj et al., 2016). In dry and semiarid settings, salinity is one of the good sized abiotic stressors that limit crop productivity. This is due to the fact soil salt attention is frequently excessive in those situations, and precipitation is generally scarce. The lack of water thru transpiration and evaporation, the buildup of salt in irrigation water, an immoderate utility of fertilizers, and an inadequate drainage gadget are all feasible reasons (Atlassi et al., 2009).

The bitter gourd that became grown in canal water served because the manage for the test and had the exceptional consequences. It had a germination of 73.68%, a germination index of 1.83%, a vine length of 14.64 cm, a leaf yield of 5.06 leaves plant⁻¹, a root length of 13.02 cm, a root biomass of 1.33 g. The bitter gourd became supplied with 2 dSm⁻¹, and it completed in 2d location. It had a germination charge of 63.64%, a germination index of 1.67, a vine length of 14.08 cm, a leaf yield of 4.94 leaves plant, a root period of 12.fifty one a root biomass of 1.23 g. The sour gourd got here in 1/3 location after being subjected to a dose of 4 dsm⁻¹ and attaining the subsequent consequences: a germination rate of 39.33%, an index of germination of 1.33, a vine length of 12.75 cm, a leaf yield of 4.94 leaves plant, a root length of 10.35 cm, a root biomass of 1.11 g. The crop that became dealt with 6 dSm⁻¹ ranked fourth with 37.23 percentage germination, a germination index of 1.21, a vine length of 8.63 cm, a leaf yield of 4.32 leaves in line with plant, a root length of 9.19 cm, a root biomass of 0.88 g. These records had been Additionally, the Bitter gourd 8 dSm⁻¹ had a germination charge of 31.93%, a germination index of 0.92, a vine length of 6.15 cm, a leaf yield of 4.10 leaves plant, a root length of 8.06 cm, a root biomass of 0.57 g.

All of those records had been primarily based totally at the seeds. The Kiran range achieved the exceptional out of these that had been evaluated. It had a germination charge of 56.52 %, an index of 4.42, a vine period of eleven.33 cm, a leaf yield of 4.67 leaves in line with plant, a root length of 10.63 cm, a root biomass of 1.54 g. In spite of this, Peshawar completed in 2d location with a germination charge of forty one 80%, a germination index of four.02, a vine period of eleven.17 cm, wide variety of leaves in line with plant of 4.63, a root period of 10.61 cm, root biomass of 0.51 g. According to the findings of the existing research, it became decided that bitter gourds that have been dealt with with canal water (the manage) exhibited the very best prices of germination and vegetative improvement This became accompanied via way of means of sour gourds that have been dealt with with 2 and 4 dsm⁻¹, in that order. In addition. Mohammed et al. consequences verify this (2017) NaCl remedy reduced shoot sparkling weight, leaf wide variety in line with plant, fruit yield, potassium concentrations in aerial parts, and chlorophyll concentrations in leaves. Higher sodium concentrations with inside the shoots had been detected in salt-pressured vegetation in comparison to manipulate vegetation that had been now no longer dealt with with NaCl.

The unfavorable outcomes of the NaCl remedy had been mitigated via way of means of the utility of SA to the leaf surfaces. Even

in vegetation that had been now no longer beneath Neath any form of stress, it became proven that SA had a useful effect, because it expanded the potassium accumulation in shoots in addition to the repute of leaf photosynthetic pigments at the same time as concurrently reducing the sodium accumulation in shoots. When salinity ranges expanded from 0 to 75 mM, the attention of sodium ions (Na⁺) with inside the roots of bitter gourd vegetation expanded the finest in comparison to the ones of different species, however the attention of sodium ions (Na⁺) with inside the leaves expanded the least. The leaves, stems, and roots of a cucumber confirmed the finest upward push in Cl content material, while the leaves, stems, and roots of a bitter gourd confirmed the least. In evaluation to the manage group, the quantity of praline located in cucumbers expanded via way of means of 3.fifty five instances, at the same time as the quantity located in bottle gourds, squash, and bitter gourds expanded via way of means of 2.0, 1.47, and 2.03 instances respectively. In cucumber, the content material of pralines had a bad correlation with RWC ($r=-0.83$, $p = 0.01$).

Other species, on the alternative hand, did now no longer showcase this form of interplay at all. Finally, many of the Cucurbitaceous species, the sour gourd had the bottom salt sensitivity primarily based totally on Na and Cl ion attention, RWC, and prolife content material, at the same time as the cucumber had the finest. Giuseppe et al. (2019) investigated the growth, yield, fruit quality, fuel line exchange, and mineral content material of bitter gourd. They in comparison the consequences from vegetation grown both engrafted or grafted onto business rootstocks after which cultivated in NFT. The engrafted vegetation produced better yields, however the grafted vegetation had better mineral content material. The fertilizer answer used to irrigate the vegetation had an EC of both 2.0 or 5.2 dSm¹. The additives of salty dietary answer had been similar to the ones of normal dietary answer, excluding the inclusion of 29 mother of sodium chloride (Bingru et al., 2018). An typical decline in output became mentioned while salt withinside the fertilizer answer expanded. The typical yield became decrease with inside the saline remedies in comparison to the controls due to the fact the fruit had been smaller. The wide variety of culmination produced in line with plant became affected.

5. CONCLUSIONS

After going through the results of the present research, it was concluded

that the seed germination and vegetative growth of bitter gourd treated under canal water (control) sued in maximum growth, followed by 2 dSm and 4 dSm".

REFERENCES

- Afzal, 1., Basra, S.M.A., Ahmad, N., and Farooq, M., 2005. Optimization of hormonal priming techniques for alleviation of salinity stress in bitter gourd. *Journal of Plant Science*, 17 (1), Pp. 95-109.
- Atlassi, P.V., Nabipour, M., and Meskarbashee, M., 2009. Effect of Salt Stress on Chlorophyll Content, Fluorescence, Nat and K⁺ Ions Content in bitter gourd. *Asian Journal of Agriculture*, 3 (1), Pp. 28-37.
- Begum, S., Ahmed, M., Siddiqui, S.B., Khan, A., Saify, Z.S., and Mohammed, A., 2017. Triterpenes, a sterol, and a monocyclic alcohol from *Momordica charantia*. *Journal of Plant Physiology*, 44 (3), Pp. 1313-1320
- Chen, Q., Chan, L.L., and Li, E.T., 2017. Bitter melon (*Momordica charantia* L.) reduces adiposity, lowers serum insulin and normalizes glucose tolerance in rats fed a high fat diet. *The Journal of Plant Nutrition*, 13 (4), Pp. 1088-1093.
- Grover, J.K., and Yadav, S.P., 2017. Pharmacological actions and potential uses of *Momordica charantia* L a review. *Journal of Ethnopharmacology*, 93 (1), Pp. 123-32.
- Krawinkel, M.B., and Keding, G.B., 2017. Bitter gourd (*Momordica charantia* Ly: A dietary approach to hyperglycemia. *Journal of Plant Nutrition Research*, 64 (1), Pp. 331-337.
- Miniraj, D.C., Das, P., Ghanti, C., and Sen, C., 2016. Downy mildew of cucurbits in West Bengal and preliminary field assessment of fungicides against Downy mildew of bitter gourd. *Journal of Plant Science*, 5 (2), Pp. 30-31.
- Munns, R., and Tester, M., 2008. Mechanism of salinity tolerance. *Annual Journal of Plant Biology*, 59 (3), Pp. 651-681.
- Qados, A., and Amira, M.S., 2011. Effect of Salt Stress in Plant Growth and Metabolism of bitter gourd plant. *Journal of the Saudi Society of Agricultural Sciences*, 10 (1), Pp. 7-15.