Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 1161-1164
Received: 17-08-2020
Accepted: 12-10-2020

**VV Rupareliya**
Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

**RK Mathukia**
Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

**BS Gohil**
Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

**PP Javiya**
Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

**Corresponding Author:**
**VV Rupareliya**
Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

# Effect of post emergence herbicides and their mixture on growth, yield and quality of soybean (*Glycine max* L.)

**VV Rupareliya, RK Mathukia, BS Gohil, PP Javiya**

**Abstract**
A field experiment was conducted on medium black calcareous clayey soil at Junagadh (Gujarat) during Kharif 2018-19 and 2019-20 to study the effect of post emergence herbicides and their mixture on growth, yield and quality of Soybean (*Glycine Max* L.). The experiment comprising 12 treatments of various combinations of herbicides were replicated thrice in a randomized block design. The experimental results revealed that next to the weed free, IC & HW at 15 and 30 DAS, pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 30 DAS, pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop + imazethapyr 50 + 75 g/ha at 30 DAS and pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS enhanced growth parameters *viz*., plant height, branches/plant, number and dry weight of root nodules/plant, dry matter/plant yield attributes like, number of pods/plant and ultimately gave higher seed and stover yields along with improved quality parameters *viz*., protein content for cultivation of soybean under South Saurashtra Agro-climatic Zone of Gujarat.

**Keywords:** Soybean, herbicide, hand weeding, post-emergence

## Introduction
The soybean (*Glycine max* L.) or soya bean is a species of legume native to East Asia, widely grown for its edible bean. Soybean is one of the most important crops in the world. This has numerous uses. Soybean has established its recognition as both a pulse and an oilseed crop and ranks third among oilseed crop grown in India.

Weed control is a practice of great importance for obtaining high soybean yields. Weed species is a serious problem for the soybean crops and its control is needed especially in infested sides. Therefore, weed management is an integral part of soybean production. Recently, research has reported that the density and distribution of weed species in the soybean plantations are significant parameters on yield losses. This happens because the weed species competes with the sunlight, water and nutrients, and may, depending on the level of infestation and species, hamper harvesting operations and compromise the quality of soybean grains. Other important biological factors in weed management decisions include weed and crop density, seed bank processes, demographic variation, weed-crop competition, and reproductive biology.

Being a rainy season crop, it suffer severely due to weed stress which is a major constraints in soybean production. Yield reduction in soybean due to poor weeds management ranges from 35 to 50 per cent depending on weed flora and their density. Although weeds pose problems during the entire crop period, but the first 30- 45 days of the crops are the most critical (Panneerselvam and Lourduraj, 2000) [13]. Therefore, major emphasis on control should be given during this period. Hand weeding is a traditional and effective method of weed control, but unavailability of labour during peak period of demand and hindrance of crop for manual weeding due to unpredictable continuous rains in the growing period make weed management in soybean a challenging task while mechanical means generally leads to root injury (Lal *et al*., 2016) [10]. Under such situations weed management through the herbicide application remains the only viable option.

## Materials and methods
A field experiment titled "Effect of post emergence herbicides and their mixture on growth, yield and quality of Soybean (*Glycine Max* L.)" was carried out at Weed Control Research Scheme, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during Kharif season of the year 2018-19 and 2019-20 on clayey soil.

The experiment having 12 treatment combinations was laid out in randomized block design with three replications *viz*., Pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 30 DAS
($T_1$), Pendimethalin 900 g/ha as pre-emergence *fb* imazethapyr 75 g/ha at 30 DAS ($T_2$), Pendimethalin 900 g/ha as pre-emergence *fb* propaquizafop 75 g/ha at 30 DAS ($T_3$), Pendimethalin 900 g/ha as pre-emergence *fb* fluazifop-p-butyl 125 g/ha at 30 DAS ($T_4$), Pendimethalin 900 g/ha as pre-emergence *fb* fomesafen 250 g/ha at 30 DAS ($T_5$), Pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop + imazethapyr 50 + 75 g/ha at 30 DAS ($T_6$), Pendimethalin 900 g/ha as pre-emergence *fb* pre-mix imazethapyr + imazamox 35 + 35 g/ha at 30 DAS ($T_7$), Pendimethalin 900 g/ha as pre-emergence *fb* pre-mix fluazifop-p-butyl + fomesafen 125 + 125 g/ha at 30 DAS ($T_8$), Pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS ($T_9$), IC & HW at 15 and 30 DAS ($T_{10}$), Weed free check ($T_{11}$) and Unweeded control ($T_{12}$) with gross and net plot sizes of 5.0 m x 3.6 m and 4.0 m x 2.7 m, respectively. The soybean (*cv*. GJS-3) was sown with standard package of practices. Irrigation to 5 cm depth applied during cropping period. Five random plants were selected from each plot excluding the border row for taking observation on growth, yield and quality parameters.

## Results and discussion

### Effect on growth and yield attributes

Growth parameters *viz.*, plant height, number of branches/plant, dry matter/plant (g) and yield attributes like, number of pods/plant at harvest (Table 1) were significantly influenced by different treatments.

Significantly higher values of growth parameters *viz*., plant height, number of branches per plant, dry matter per plant harvest and yield attributes like, number of pods/plant at harvest were observed under the weed free check ($T_{11}$), but it was found statistically at par with IC & HW at 15 and 30 DAS ($T_{10}$), pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 30 DAS ($T_1$), pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop + imazethapyr 50 + 75 g/ha at 30 DAS ($T_6$) and pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS ($T_9$) in most of the cases in pooled data.

Effective control of weeds through manual weeding in the weed free check ($T_{11}$), IC & HW at 15 and 30 DAS ($T_{10}$) as well as combination of pre-emergence herbicide with manual weeding under application of pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 30 DAS ($T_1$). While, improved growth parameters and yield parameters under the application of pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop + imazethapyr 50 + 75 g/ha at 30 DAS ($T_6$) and pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS ($T_9$) were attributed to better control of weeds from initial stage by pre-emergence application of pendimethalin and post-emergence application of pre-mix propaquizafop + imazethapyr or sodium acifluorfen + clodinafop-propargyl as evidenced by less crop-weed competition throughout growth period of the crop, less count and dry weight of weeds, which might have resulted in better availability of space, sunlight, moisture and nutrients to the crop in absence of weeds. Thus, increased water and nutrient uptake, which might have accelerated photosynthetic rate, thereby increasing the supply of carbohydrates, resulted in cell division, multiplication and elongation leading to increase in growth character and yield attributes. These findings are in agreement with those of Gohil (2015) [4, 5], Jakhar and Sharma (2015) [9], Muttanna (2015) [11], Sandil *et al.*, (2015) [16], Harithavardhini *et al*., (2017) [7], Nishant (2018) [12], Rohit and Narayan (2018) [15] and Patil *et al.*, (2019) [14].

**Table 1:** Effect of different treatments on growth and yield attributes of soybean at harvest (Pooled over two years)

| Treatment | Plant height (cm) | Number of branches/plant | Dry matter/plant (g) | Number of pods/plant |
|---|---|---|---|---|
| $T_1$:IC & HW at 30 DAS | $52.56^{ab}$ | $6.03^{ab}$ | $31.77^{a}$ | $49.86^{ab}$ |
| $T_2$:Imazethapyr 75 g/ha at 30 DAS | $48.27^{bc}$ | $5.17^{cde}$ | $26.20^{b}$ | $47.81^{b}$ |
| $T_3$:Propaquizafop 75 g/ha at 30 DAS | $47.14^{c}$ | $4.62^{ef}$ | $22.56^{c}$ | $40.16^{cd}$ |
| $T_4$:Fluazifop-p-butyl 125 g/ha at 30DAS | $46.85^{c}$ | $4.38^{f}$ | $20.26^{d}$ | $36.79^{d}$ |
| $T_5$:Fomesafen 250 g/ha at 30 DAS | $46.64^{c}$ | $4.20^{f}$ | $19.24^{d}$ | $36.60^{d}$ |
| $T_6$:Pre-mix Propaquizafop + Imazethapyr 50 + 75 g/ha at 30 DAS | $51.50^{abc}$ | $5.87^{abc}$ | $31.51^{a}$ | $49.57^{ab}$ |
| $T_7$:Pre-mix Imazethapyr + Imazamox 35 + 35 g/ha at 30 DAS | $49.84^{abc}$ | $5.23^{cde}$ | $26.58^{b}$ | $48.80^{ab}$ |
| $T_8$:Pre-mix Fluazifop-p-butyl + Fomesafen 125 + 125 g/ha at 30 DAS | $47.5^{bc}$ | $4.92^{def}$ | $23.45^{c}$ | $42.56^{c}$ |
| $T_9$:Pre-mix Sodium Acifluorfen + Clodinafop-propargyl 80 + 165 g/ha at 30 DAS | $50.31^{abc}$ | $5.57^{bcd}$ | $27.64^{b}$ | $48.84^{ab}$ |
| $T_{10}$:IC & HW at 15 and 30 DAS | $52.70^{ab}$ | $6.10^{ab}$ | $32.37^{a}$ | $50.20^{ab}$ |
| $T_{11}$:Weed free check | $55.02^{a}$ | $6.40^{a}$ | $33.42^{a}$ | $53.70^{a}$ |
| $T_{12}$:Unweeded control | $37.61^{d}$ | $3.13^{g}$ | $16.27^{e}$ | $16.60^{e}$ |
| S.Em.± | 1.61 | 0.24 | 0.72 | 1.74 |
| C.D. at 5% | 4.58 | 0.68 | 2.05 | 4.96 |
| C.V.% | 8.06 | 11.35 | 6.81 | 9.81 |

Note: Pendimethalin 900 g/ha was applied as pre-emergence in the treatments $T_1$ to $T_9$. Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Rang Test at 5% level of significance.

### Effect on crop yield

A perusal of data revealed that different weed management treatments exhibited their significant influence on seed and stover yields (Table 2) of soybean. Significantly higher seed and stover yields of soybean were recorded under the weed free check ($T_{11}$), but it remained statistically equivalent to IC & HW at 15 and 30 DAS ($T_{10}$), pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 30 DAS ($T_1$), pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop + imazethapyr 50 + 75 g/ha at 30 DAS ($T_6$) and pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS ($T_9$) in 2018, 2019 and pooled data. The magnitude of increase in seed yield of soybean with the $T_{11}$, $T_{10}$, $T_1$, $T_6$ and $T_9$ was to the

tune of 145.8, 141.0 and 143.3%, 135.6, 129.5 and 132.5%, 123.4, 127.9 and 125.7%, 119.0, 122.0 and 120.5% and 112.9, 107.2 and 110.0% over $T_{12}$ in 2018, 2019 and pooled results, respectively. Similarly, the extent of increase in stover yield of soybean with the $T_{11}$, $T_{10}$, $T_1$, $T_6$ and $T_9$ over the treatment $T_{12}$ was 101.9, 106.2 and 104.1%, 96.1, 98.4 and 97.3%, 89.7, 87.1 and 88.4%, 87.5, 85.7 and 86.6% and 82.7, 79.7 and 81.2% in 2018, 2019 and pooled results, respectively.

Pre-mix propaquizafop + imazethapyr and sodium acifluorfen + clodinafop-propargyl are post-emergence herbicides with broad spectrum activity on grasses and broad-leaved weeds compared to the unweeded control and the other herbicide treatments, thereby resulting in a significant increase in soybean yield. The present findings are within the close vicinity of those reported with different weed management treatments by Gohil *et al.,* (2015) [4, 5], Ahirwar *et al.,* (2018) [1], Jai *et al.,* (2018) [8], Anuj *et al.,* (2019) [2].

**Table 2:** Effect of different treatments on yield of soybean at harvest

| Treatment | Seed yield (kg/ha) | | | Stover yield (kg/ha) | | |
|---|---|---|---|---|---|---|
| | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| $T_1$:IC & HW at 30 DAS | 2034$^{abc}$ | 2145$^{a}$ | 2090$^{ab}$ | 3584$^{a}$ | 3639$^{a}$ | 3611ab |
| $T_2$:Imazethapyr 75 g/ha at 30 DAS | 1580$^{cde}$ | 1759$^{abc}$ | 1670$^{cde}$ | 2675$^{bc}$ | 2764$^{bcd}$ | 2720$^{c}$ |
| $T_3$:Propaquizafop 75 g/ha at 30 DAS | 1349$^{defg}$ | 1392$^{cde}$ | 1370$^{ef}$ | 2243$^{cd}$ | 2367$^{de}$ | 2305$^{cde}$ |
| $T_4$:Fluazifop-p-butyl 125 g/ha at 30DAS | 1194$^{efg}$ | 1244$^{de}$ | 1219$^{fg}$ | 2215$^{cd}$ | 2350$^{de}$ | 2282$^{cde}$ |
| $T_5$:Fomesafen 250 g/ha at 30 DAS | 1003$^{fg}$ | 1056$^{de}$ | 1029$^{g}$ | 2091$^{cd}$ | 2228$^{de}$ | 2159$^{de}$ |
| $T_6$:Pre-mix Propaquizafop + Imazethapyr 50 + 75 g/ha at 30 DAS | 1994$^{abc}$ | 2090$^{a}$ | 2042$^{ab}$ | 3543$^{a}$ | 3611$^{a}$ | 3577$^{ab}$ |
| $T_7$:Pre-mix Imazethapyr + Imazamox 35 + 35 g/ha at 30 DAS | 1710$^{bcd}$ | 1806$^{abc}$ | 1758$^{bcd}$ | 3133$^{ab}$ | 3291$^{abc}$ | 3212$^{b}$ |
| $T_8$:Pre-mix Fluazifop-p-butyl + Fomesafen 125 + 125 g/ha at 30 DAS | 1444$^{def}$ | 1497$^{bcd}$ | 1471$^{def}$ | 2433$^{cd}$ | 2574$^{cde}$ | 2504$^{cd}$ |
| $T_9$:Pre-mix Sodium Acifluorfen + Clodinafop-propargyl 80 + 165 g/ha at 30 DAS | 1938$^{abc}$ | 1951$^{ab}$ | 1944$^{abc}$ | 3452$^{a}$ | 3494$^{ab}$ | 3473$^{ab}$ |
| $T_{10}$:IC & HW at 15 and 30 DAS | 2145$^{ab}$ | 2160$^{a}$ | 2153$^{a}$ | 3704$^{a}$ | 3858$^{a}$ | 3781$^{a}$ |
| $T_{11}$:Weed free check | 2238$^{a}$ | 2269$^{a}$ | 2253$^{a}$ | 3814$^{a}$ | 4009$^{a}$ | 3912$^{a}$ |
| $T_{12}$:Unweeded control | 910$^{g}$ | 941$^{e}$ | 926$^{g}$ | 1889$^{d}$ | 1944$^{e}$ | 1917$^{e}$ |
| S.Em.± | 155 | 154 | 109 | 222 | 243 | 164 |
| C.D. at 5% | 454 | 454 | 312 | 652 | 714 | 470 |
| C.V.% | 16.50 | 15.85 | 16.17 | 13.30 | 14.01 | 13.68 |

Note: Pendimethalin 900 g/ha was applied as pre-emergence in the treatments $T_1$ to $T_9$. Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Rang Test at 5% level of significance.

**Effect on quality parameters**

The effect of different weed management treatments found significant on seed protein content and oil yield (Table 3) in pooled data. Significantly higher seed protein content and oil yield were recorded under the weed free check ($T_{11}$), which was followed by IC & HW at 15 and 30 DAS ($T_{10}$), pendimethalin 900 g/ha as pre-emergence *fb* IC & HW at 30 DAS ($T_1$), pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop + imazethapyr 50 + 75 g/ha at 30 DAS ($T_6$) and pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS ($T_9$). This can be ascribed to better control of weeds by manual weeding and herbicides as compared to the un weeded condition, which might have increased absorption of nitrogen and water by the crop and the least by weeds which in turn enhanced assimilation of nitrogen leading to increased synthesis of amino acid so that increased the seed protein content. Higher seed yield with the above mentioned treatments ultimately resulted in higher oil yield. A glance of oil content data revealed that there was no significant effect weed management treatments in pooled results (Table 2). Similar results have been found by Gupta and Saxena (2008) [6] and Bharat *et al.,* (2019) [3].

**Table 3:** Effect of different treatments on quality parameters of soybean (Pooled over two years)

| Treatment | Protein content (%) | Oil content (%) | Oil yield (kg/ha) |
|---|---|---|---|
| $T_1$:IC & HW at 30 DAS | 33.3$^{ab}$ | 20.22 | 421$^{ab}$ |
| $T_2$:Imazethapyr 75 g/ha at 30 DAS | 30.07$^{cd}$ | 19.52 | 326$^{de}$ |
| $T_3$:Propaquizafop 75 g/ha at 30 DAS | 29.41$^{d}$ | 18.70 | 255$^{f}$ |
| $T_4$:Fluazifop-p-butyl 125 g/ha at 30DAS | 29.41$^{d}$ | 18.64 | 227$^{fg}$ |
| $T_5$:Fomesafen 250 g/ha at 30 DAS | 29.22$^{d}$ | 18.12 | 186$^{g}$ |
| $T_6$:Pre-mix Propaquizafop + Imazethapyr 50 + 75 g/ha at 30 DAS | 32.64$^{ab}$ | 20.04 | 410$^{abc}$ |
| $T_7$:Pre-mix Imazethapyr + Imazamox 35 + 35 g/ha at 30 DAS | 30.55$^{cd}$ | 19.64 | 344$^{cde}$ |
| $T_8$:Pre-mix Fluazifop-p-butyl + Fomesafen 125 + 125 g/ha at 30 DAS | 29.98$^{cd}$ | 19.49 | 284$^{ef}$ |
| $T_9$:Pre-mix Sodium Acifluorfen + Clodinafop-propargyl 80 + 165 g/ha at 30 DAS | 31.50$^{bc}$ | 19.92 | 388$^{bcd}$ |
| $T_{10}$:IC & HW at 15 and 30 DAS | 33.59$^{a}$ | 20.53 | 443$^{ab}$ |
| $T_{11}$:Weed free check | 33.88$^{a}$ | 20.64 | 465$^{a}$ |
| $T_{12}$:Unweeded control | 28.93$^{d}$ | 17.37 | 161$^{g}$ |
| S.Em.± | 0.60 | 0.73 | 22.01 |
| C.D. at 5% | 1.71 | NS | 62.72 |
| C.V.% | 4.73 | 9.26 | 16.55 |

Note: Pendimethalin 900 g/ha was applied as pre-emergence in the treatments $T_1$ to $T_9$. Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Rang Test at 5% level of significance.

**Conclusion**

On the basis of the results obtained from the present two-year field experimentation, it seems quite logical to conclude that higher growth attributes, yield attributes and yield and quality of Soybean (*cv.* GJS-3) can be secured by pendimethalin 900 g/ha as pre-emergence *fb* pre-mix propaquizafop +

imazethapyr 50 + 75 g/ha at 30 DAS or pendimethalin 900 g/ha as pre-emergence *fb* pre-mix sodium acifluorfen + clodinafop-propargyl 80 + 165 g/ha at 30 DAS. Alternatively, pendimethalin 900 g/ha as pre-emergence *fb* either IC & HW at 30 DAS or IC & HW at 15 and 30 DAS can be employed according to availability of labourers under medium black calcareous clayey soil of South Saurashtra Agro-climatic Zone.

**References**


1. Ahirwar SK, Ahirwar AD, Alawa SL, Deshmukh G. Effect of weed management and fertility levels on productivity and economics of soybean in central Narmada valley of Madhya Pradesh, India. International Journal of Current Microbiology and Applied Sciences 2018;7(2):3543-3548.
2. Anuj RT, Dogendra KS, Ravi RS, Radhika B, Punam LK, Smita BB. Effect of integrated weed management on biological properties of soil, crop growth and productivity of soybean. Journal of Pharmacognosy and Phytochemistry 2019;8(1):1192-1193.
3. Bharat CH, Bhushan R, Srinivas A, Ramprakash T. Impact of integrated weed management and bio-fertilizers on growth and quality of kharif soybean. Journal of Pharmacognosy and Phytochemistry 2019;5(S):461-463.
4. Gohil BS. Integrated management of weed seedbank in kharif groundnut grown after wheat. Ph.D. Thesis (Unpublished). Junagadh Agricultural University, Junagadh (Gujarat) 2015.
5. Gohil BS, Mathukia RK, Dobariya VK, Chhodavadia S K. Potential of weed seedbank dynamics and economic feasibility of weed management practices in rabi fennel. Journal of Crop and Weed 2015;11(S):210-216.
6. Gupta A, Saxena SC. Weed management in soybean in Tarai region of Uttarakhand to sustain productivity. Pantnagar Journal of Research 2008;6(1):1-5.
7. Harithavardhini J, Jayalalitha K, Ashoka RY, Krishnaveni B. Effect of post emergence herbicides on photosynthetic pigments, antioxidant enzyme activity and yield of blackgram. Pharmacology and Life Sciences 2017;6(3):20-26.
8. Jai PB, Arvind V, Versha G, Arunima P, Vasudev M. Residual studies of herbicides and nutrient management in wheat following an application to soybean. International Journal of Chemical Studies 2018;6(2): 3637-3640.
9. Jakhar RR, Sharma R. Growth and yield attributes as influenced by integrated weed management in soybean. Advanced Research Journal of Crop Improvement 2015;6(2):129-133.
10. Lal S, Dubey RP, Das GK, Suryavanshi T. Energy budgeting of weed management in soybean. Indian Journal of Weed Science 2016;48(4):394-399.
11. Muttanna K. Effect of post-emergence herbicide cycloxydim 20% EC on weeds, growth and yield of soybean. M.Sc. (Agri.) Thesis (Unpublished). University of Agricultural Sciences, Dharwad (Karnataka) 2015.
12. Nishant K, Tigga R. Effect of sowing date and weed management techniques on yield attributes and yield of blackgram. International Journal of Chemical Studies 2018;6(6):2705-2708.
13. Panneerselvam S, Lourduraj AC. Weed spectrum and effect of crop weed competition in soybean. Agricultural Reviews 2000;21(2):121-124.
14. Patil AS, Bhavsar MS, Deore PS, Raut DM. 2019. Effect of integrated weed management on weed dynamics of soybean [*Glycine max* (L.) Merill] under Junagadh, India. International Journal of Current Microbiology Applied Sciences 2000;7(1):1110-1115.
15. Rohit BU, Narayan BP. Effect of integrated weed management on growth, productivity and economics of soybean. International Journal of Academic Research and Development 2018;3(2):650-652.
16. Sandil MK, Sharma JK, Sanodiya P, Pandey A. Bio-efficacy on tank mixed propaquizafop and imazethapyr against weeds in soybean. Indian Journal of Weed Science 2015;47(2):158-162.