Plant Archives Vol. 24, No. 2, 2024 pp. 1596-1600 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.439

OPTIMIZING THE GROWTH AND PRODUCTIVITY OF PEARL MILLET THROUGH SOWING WINDOW AND VARIETY SELECTION IN SCARCITY ZONE

Sujeet S. Deshmukh[1]*, Sapana K. Rahase[1], Vishal D. Wale [1] and Ranjeet S. Deshmukh[2]

[1]Department of Agricultural Meteorology, College of Agriculture, Pune, (M.P.K.V. Rahuri) Pune, Maharashtra 411005 , India

[2]Department of Agricultural Entomology, College of Agriculture, Pune, (M.P.K.V. Rahuri) Pune, Maharashtra 411005 , India

*Corresponding author -E-mail: sujeetdeshmukh99@gmail.com; Contact: 8975690058

Address for Correspondance: Sujeet S. Deshmukh, Boys Hostel, College of Agriculture, Shivajinagar, Pune- 411005 , India Maharashtra

(Date of Receiving-20-03-2024; Date of Acceptance-11-06-2024)

ABSTRACT

This study investigates the influence of sowing windows and varieties on plant height and dry matter accumulation in pearl millet (*Pennisetum glaucum* L.) across two consecutive years, 2021 and 2022. Diverse sowing windows significantly impact plant height and dry matter accumulation with earlier sowing generally resulting superiority in these parameters. Optimal results were achieved with the second fortnight of June sowing window (S_1: 25th June - 01st July), showing superior plant height and growth parameters. Among the evaluated cultivars ICTP-8203, Mahyco hybrid, and Adishakti cultivar "Adishakti" stood out, displaying significantly higher plant height, growth parameters, and dry matter accumulation.

***Key words*:** Pearl millet, sowing windows, variety, plant height, dry matter

Introduction

Pearl millet (*Pennisetum glaucum* L.) stands as India's fourth most extensively grown food crop, following rice, wheat, and maize. Cultivated across a vast expanse of 6.93 million hectares, it yields an average of 8.61 million tons with a productivity rate of 1,243 kg/ha (Anonymous, 2021). In Maharashtra alone, pearl millet occupies 0.70 million hectares, resulting in an average production of 0.63 million tons (Anonymous, 2020).

Pearl millet is a critically important staple crop with a global presence, primarily cultivated in arid and semi-arid regions. In the Maharashtra state, pearl millet cultivation assumes a significant role in ensuring food security and livelihoods, particularly in regions grappling with water scarcity issues.Understanding the optimal sowing window and selecting suitable pearl millet varieties in scarcity zones is crucial for maximizing resource efficiency, enhancing climate resilience, and mitigating risks associated with water scarcity and erratic weather patterns.

Material and Methods

Agro-climatically the Zonal Agricultural Research Station, Solapur comes under dry (Arid and Semi-arid) zone. Geographically the campus of Mulegaon Agricultural Farm is situated on 17º41' N latitude and 75º 56'E longitude. The altitude is about 483.6 M above mean sea level. The temperature range was 21 to 34ºC. The layout of experimental field was laid out with 9 treatment combinations in 3 replications. Gross plot size was 15.0 × 6.3 m^2 and net plot size was 10.0 × 4.5 m^2. A distance of 1.5 m was kept between the plots. For this experiment split plot design was used with spacing 45×15 cm and seed rate 3-4 kg ha^{-1}.

Treatment details:

I. Main Treatment: (3 sowing windows)

1. S_1 = Second fortnight of June. 26 MW (25th June – 01st July)
2. S_2 = Second fortnight of July. 30 MW (23rd July - 29th July)

3. S_3= Second fortnight of August. 35 MW (27th Aug – 02nd Sep.)

II. Sub plot treatment: (3 Varieties)

1. V_1 = ICTP – 8203
2. V_2 = Mahyco hybrid
3. V_3 = Adishakti

Plant height (cm)

The plant height was measured from the base of the plant i.e. ground level to the tip of the fully opened upper leaf of the five randomly selected plants in each net plot at an interval of 15 days from 30 DAS till harvest. An average plant height was recorded.

Dry matter plant^{-1} (g)

To determine the dry matter plant^{-1} one representative plant sample from each net plot was uprooted and observations were recorded at 30, 45, 60, 75, 90 DAS and at harvest. The material was chaffed and was first air drying later on and they were kept for oven drying at 60 + 2°C till constant weight were obtained. After weighing the material, the dry matter of plant was recorded.

Result and Discussion

Plant height (cm)

The data pertaining to mean plant height (cm) as influenced periodically by different treatments during both the years of *kharif* season is presented in Table 1 and graphically depicted in Fig. 1-2. The mean plant height

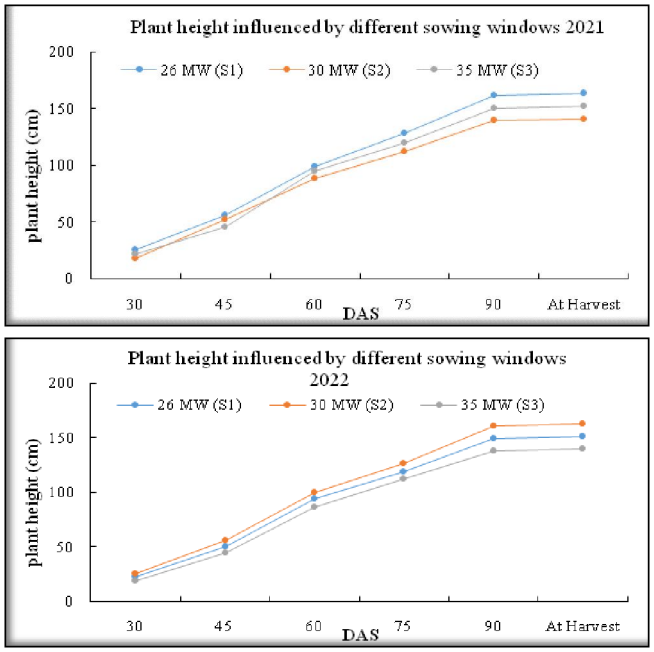

Fig. 1: Plant height (cm) of as influenced periodically by different sowing windows of *kharif* pearl millet 2021 and 2022.

increased as the crop advanced in age. The mean plant height increased from 30 DAS (21.84 cm) to harvest (152.04 cm) during 2021 and from 30 DAS (22.10 cm) to harvest (151.03 cm) during 2022.

Effect of sowing windows:

The average plant height was notably affected by the distinct growing conditions established via various sowing windows over the entire crop growth duration.

Table 1: Plant height (cm) of as influenced periodically by different treatments in *kharif* pearl millet 2021 and 2022.

Treatment	30 DAS		45 DAS		60 DAS		75 DAS		90 DAS		At Harvest	
Sowing window	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
S_1:26 MW (25th June - 01st July)	25.41	22.39	56.36	50.74	98.57	94.29	127.82	118.57	161.76	149.54	163.42	150.65
S_2: 30MW (23rd July - 29th July)	18.26	25.29	52.43	55.64	88.73	99.86	112.49	126.3	139.3	161.05	140.52	162.58
S_3: 35 MW (27th Aug - 02nd Sep)	22.06	18.63	45.51	44.8	95.06	86.12	119.32	111.74	150.06	138.19	151.83	139.51
S.E (m)±	0.65	0.64	0.72	0.65	1.31	1.24	1.33	1.57	3.29	3.47	2.94	3.13
C.D at 5%	2.25	2.22	2.47	2.24	4.53	4.29	4.6	5.42	9.37	10.24	9.41	10.08
Varieties												
V_1: ICTP-8203	18.93	19.24	44.72	43.01	90.88	90.06	113.41	110.52	140.6	139.78	141.17	140.86
V_2: Mahyco Hybrid	21.47	21.84	51.02	48.29	95.01	95.47	120.72	117.89	151.39	150.71	152.35	151.41
V_3: Adishakti	24.88	25.22	57.56	56.89	99.23	100.72	128.91	125.2	161.13	160.29	162.96	161.17
S.E (m)±	0.54	0.57	0.68	0.71	1.47	1.48	2.04	2.02	3.02	3.01	3.19	3.01
C.D at 5%	1.59	1.68	2.01	2.1	3.37	3.48	5.45	5.23	7.96	7.94	8.90	8.76
Interaction effect												
S.E (m)±	0.93	0.98	1.17	1.22	2.55	2.56	3.53	3.5	5.23	5.21	5.53	5.22
C.D at 5%	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S
G.Mean	21.84	22.10	51.27	49.90	94.58	94.42	120.45	118.37	150.71	149.93	152.04	151.03

Table 2: Mean dry matter plant^{-1} as influenced periodically by different treatments in *kharif* pearl millet 2021 and 2022.

Treatment	30 DAS		45 DAS		60 DAS		75 DAS		90 DAS		At Harvest	
Main Plot Sowing window	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
S_1:26 MW (25th June - 01st July)	10.28	6.82	21.5	16.63	42.9	35.9	63.8	54.48	85.3	77.3	91.3	83.8
S_2: 30MW (23rd July - 29th July)	5.04	9.68	13.06	21.0	30.9	41.56	47.3	62.37	65.4	84.19	75.8	90.2
S_3: 35 MW (27th Aug - 02nd Sep)	7.94	4.66	17.87	12.69	36.4	29.68	55.9	47.4	74.1	70.2	84.6	77.5
S.E (m)±	0.17	0.06	0.61	0.28	1.06	1.02	1.56	1.23	1.94	1.38	2.06	1.56
C.D at 5%	0.29	0.21	2.24	2.11	3.66	3.46	5.38	5.12	5.78	5.14	5.42	5.06
Sub plot : Varieties												
V_1: ICTP-8203	5.26	6.62	14.29	13.44	31.5	30.5	51.6	52.6	70.5	68.6	78.9	77.8
V_2: Mahyco Hybrid	6.91	7.52	17.61	16.85	36.3	35.8	57.36	56.4	76.3	75.4	84.45	82.1
V_3: Adishakti	9.82	9.18	21.2	20.88	41.80	40.3	63.08	61.7	84.81	83.8	90.78	89.2
S.E (m)±	0.07	0.05	0.28	0.21	0.61	0.52	0.89	0.71	1.18	1.06	1.21	1.15
C.D at 5%	0.13	0.10	1.31	1.22	1.8	1.71	2.64	2.12	3.10	3.02	3.5	3.45
Interaction effect												
S.E (m)±	0.06	0.09	0.25	0.36	0.74	1.05	1.08	1.54	1.35	1.92	1.43	2.04
C.D at 5%	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S
G.Mean	7.54	7.41	17.59	16.92	36.63	35.62	56.51	55.83	76.07	76.58	84.31	83.43

Plant height exhibited a consistent increase as the crop matured, with the highest plant height observed at the point of maturity. (Table 1).

Differential sowing windows significantly influenced plant height across all growth stages. Sowing windows of 26 MW (S_1) and 30 MW (S_2) demonstrated the greatest plant height, reaching 163.42 cm and 162.58 cm, respectively. Subsequently, sowing windows at 35 MW (S3) and 26 MW (S_1) exhibited heights of 151.83 cm and 150.65 cm, while notably diminished plant heights were observed in sowing windows of 30 MW (S_2) and 35 MW (S_3), measuring 140.52 cm and 139.51 cm at harvest in the experimental years 2021 and 2022, respectively. These findings showed the significant impact of varying sowing windows on plant height outcomes over the studied period.

The plant height displayed a rapid increase between 30 to 75 days after sowing (DAS), likely attributable to the active growth phases of the initial stages of the plant. Beyond 75 DAS, the rate of height increase slowed down, corresponding to the transition from early growth stages to the maturity phase. In 2021, during the crop growth period, the first sowing window (S_1) exhibited a significantly greater plant height compared to the other sowing windows, while in 2022, the second sowing window (S_2) demonstrated a significantly superior plant height. This increase in plant height could be attributed to favorable weather conditions, optimal rainfall and soil moisture levels around the root zone which facilitated improved nutrient uptake and translocation, ultimately contributing to enhanced plant growth and development in terms of plant height.Increased plant height with increasing level of soil moisture was also reported by Similar results were recorded by Kaushik and Gautam (1984), Jadhav *et al*., (1995), Andhale *et al*., (2003). This suggests that timely sowing of crop with respect to abundant soil moisture can promote better growth, development, and ultimately, higher crop yields.

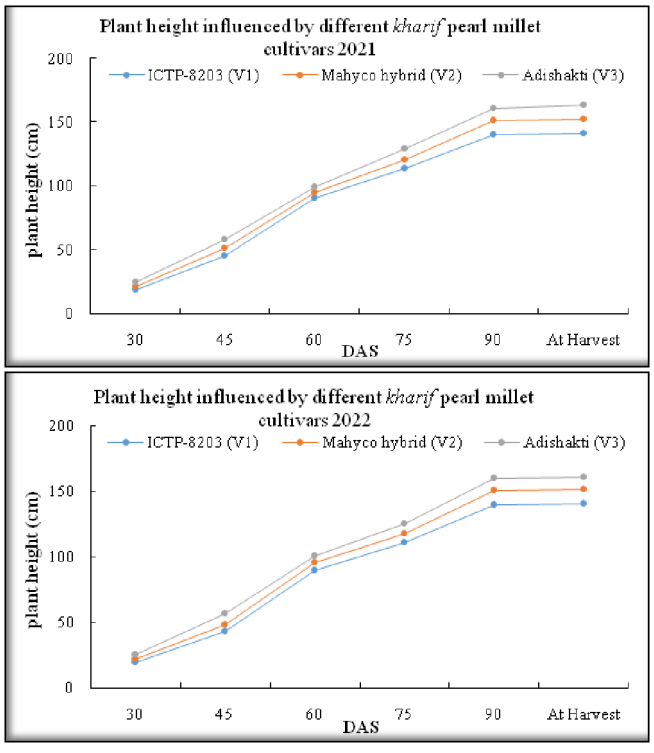

Fig. 2: Plant height (cm) of as influenced periodically by different varieties of *kharif* pearl millet 2021 and 2022.

Effect of varieties

Significant varietal differences in mean plant height were observed across all stages of crop growth in both the years 2021 and 2022. Notably, variety Adishakti (V_3) consistently exhibited the highest plant height, measuring 162.96 cm and 161.17 cm during the respective years. Following this, Mahyco hybrid (V_2) displayed a intermediate plant height of 152.35 cm and 151.41 cm for 2021 and 2022, respectively. In contrast, variety ICTP-8203 (V_1) consistently demonstrated the lowest plant height among all varieties, recording 141.17 cm and 140.86 cm across all growth stages in the years 2021 and 2022.

This suggests that the variety Adishakti (V_3) has the potential to exhibit vigorous growth and achieve taller plant height compared to the other varieties tested. The significant differences in plant height among the varieties indicate that genetic factors, hormonal balance, nutrient absorbing capacity and photosynthetic ability play a crucial role in determining the growth and development of pearl millet. Adishakti and Mahyco hybrid demonstrate favorable attributes for achieving taller plant heights, while ICTP-8203 appears to have limitations in this aspect. Variety Adishakti suitably acclimatize in soil and agro-climatic conditions of scarcity zone region thus, exploiting its potential in term of growth and development. All these processes were reflected in height and other yield contributing characters. Increase in plant height due to favorable weather situations like higher GDD, photo thermal and helio-thermal units which facilitates better growth.

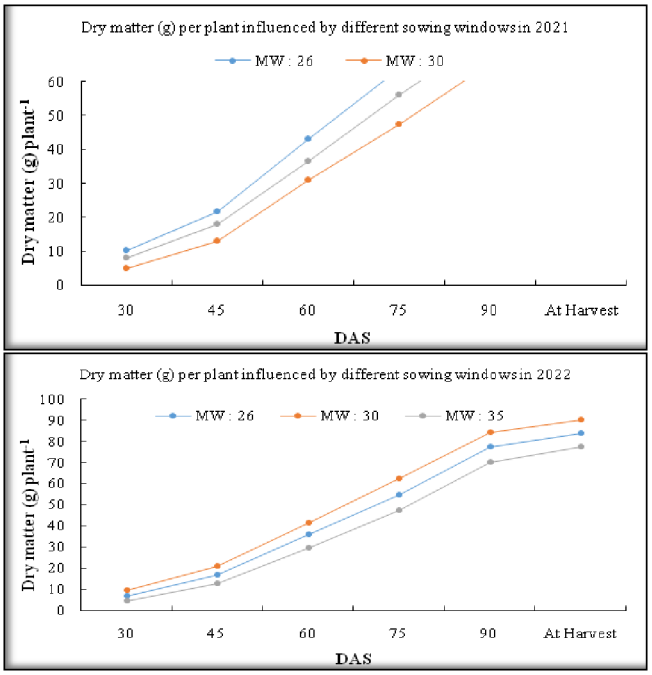

Fig. 3: Mean dry matter plant^{-1} as influenced periodically bydifferent sowing windows of *kharif* pearl millet in 2021 and 2022.

Total dry matter accumulation plant^{-1} (g)

The accumulation of dry matter plant^{-1} (g) is probably the best index of growth put forth by the crop. Relevant data to this character recorded at various stages are presented in Table 2 and graphically depicted in Fig. 3-4. During the crop growing period, increase in dry matter weight was continuous with the advancement in the crop age up to harvest of crop. The rate of increase was rapid during flowering and reproductive period.

Effect of sowing windows

The mean dry matter accumulation plant^{-1}was significantly influenced throughout the crop growth period by different growing environments created through different sowing windows. The mean dry matter accumulation plant^{-1} (g) was increased with advancement of the crop age, and it was recorded highest at harvest (Table 2).

Diverse sowing windows exerted a significant influence on the mean dry matter accumulation throughout various growth stages. Specifically, sowing windows of 26 MW (S_1) and 30 MW (S_2) exhibited the highest levels of dry matter, measuring 91.3 g and 90.2 g, respectively. Sequentially, sowing windows at 35 MW (S_3) and 26 MW (S_1) recorded dry matter values of 84.6 g and 83.8 g. Conversely, diminished dry matter content was observed in sowing windows of 30 MW (S_2) and 35 MW (S_3) 75.8 g and 77.5 g at the time of harvesting in

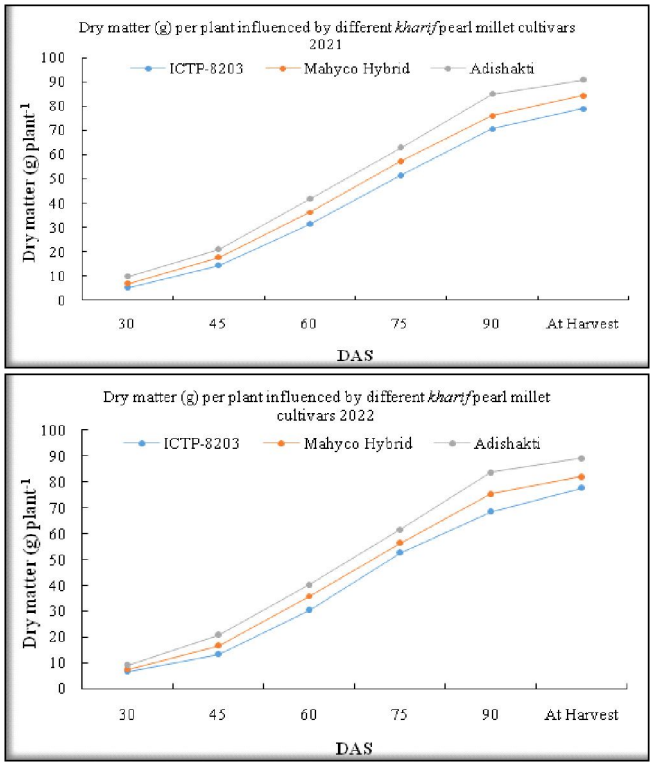

Fig. 4: Mean dry matter plant^{-1} as influenced periodically by different varieties of *kharif* pearl millet in 2021 and 2022.

the years 2021 and 2022, respectively. These results indicate significant variability in dry matter accumulation among the different sowing windows over the two years of experimentation.

Dry matter accumulation in pearl millet (*Pennisetum glaucum*) was investigated over two consecutive years, 2021 and 2022. The growth pattern showed a rapid increase in dry matter accumulation between 45 and 75 days after sowing (DAS), attributed to the plant's active growth phases. Subsequently, beyond 75 DAS, dry matter accumulation rate slowed down as the plant transitioned into the harvesting stage, reaching its maximum potential. During the crop growth period, sowing windows (S_1) and (S_2) showed significantly superior dry matter accumulation compared to other sowing windows. This difference in growth performance might be attributed to the favorable weather conditions and varying weather parameters experienced during the two years of crop's growing period.

Conversely, the extended sowing window (S_3) resulted in reduced dry matter production, likely due to a shortened growth period associated with late sowing. This finding reinforces the negative impact of delayed sowing on dry matter production in pearl millet. The outcomes of this study align with previous research conducted by Anonymous (2009), which also reported similar trends in dry matter accumulation during the sowing of pearl millet in the *kharif* season. As water is not a limiting factor, plantcan absorb more nutrients from soil, which encourages physiological processes such as cell division and cell expansion. Hence leaves/plant increased and ultimately it reflected in higher dry matter accumulation. The dry matter is a cumulative effect of all growth parameters like plant height, number of tillers etc.

Effect of varieties

The significant variations in the mean dry matter plant^{-1} of pearl millet were observed across different varieties at all stages of crop growth in both 2021 and 2022 . Notably, variety Adishakti (V_3) exhibited the highest dry matter accumulation at harvest, recorded 90.78 and 89.2 g in the respective years, followed by Mahyco hybrid (V_2) with 84.45 and 82.1 g, and ICTP-8203 (V_1) with 78.09 g and 77.8 g it was lowest in all varietiesduring the two years of crop's growing period respectively.

The observed differences in dry matter accumulation can be attributed to the significant growth and yield parameters associated with variety Adishakti. This particular variety evidently maximized its full potential under the prevailing agro-climatic conditions, resulting in superior dry matter accumulation.

Effect of interaction:

The interaction effects between sowing windows and varieties were found to be non-significant concerning total dry matter accumulation plant^{-1} (g) at all growth stages in both experimental trials.

Conclusion

The study indicated that, both sowing windows and varieties significantly influence plant height and dry matter accumulation. The *kharif* pearl millet sown during the second fortnight of June, sowing window S_1 (25th June - 01st July) 26 MW, was identified as the optimal timeframe for achieving superior plant height, growth parameters and dry matter. Among the three evaluated cultivars, ICTP-8203, Mahyco hybrid and Adishakti cultivar "Adishakti" displayed a significant superiority, resulting in substantially higher plant height, growth parameters and dry matter. Favourable weather conditions and soil moisture levels, contribute to enhanced plant height and dry matter accumulation in scarcity zone.

Acknowledgements

Authors acknowledge the support from Department of Agricultural Meteorology, Mahatma Phule Krishi Vidyapeeth, Rahuri and Zonal Agricultural Research Station, Solapur, Maharashtra.

References

Andhale, R.P. Shinde S.H. and Pawar V.S. (2003). Effect of sowing dates on growth and yield of pearl millet. *J. Agromet*. **5(2)**, 102-105.

Anonymous (2009). Report on Bajra and minor millet presented in Research review subcommittee held at M.P.K.V, Rahuri during. 26-27.

Anonymous (2020). Annual report- Directorate of Economics and Statistics.

Anonymous (2021). Annual report- Directorate of Millets Development and Research.

Govindaraj, M., Rai K.N., Shanmugasundaram P. and Dwivedi S.L. (2010). Pearl Millet Breeding Lines Developed at ICRISAT: Their Performance and Genetic Diversity. SAT. e. Journal, **8(1)**, 1-5. https://doi.org/10.1007/s12298-010-0001-6

Jadhav, A.S. Dukare N.S. and Shaikh A.A. (1995). Contribution of production factors to yield of rainfed pearl millet. *J. Maharashtra Agric. Univ*. **19(30)**, 385-387.

Kaushik, S.K. and Gautam R.C. (1984). Effect of varying dates of planting and row spacing on yield of pearl millet varieties under rainfed conditions. *Indian J. Agron*. **29(3)**, 480-484.

Vadez, V., Deshpande S. P., Kholova J. and Hammer G. L. (2011). Boron toxicity tolerance in pearl millet. Field Crops Research, **120(1)**, 241-248. https://doi.org/10.1016/j.fcr.2010.10.001.